HYDROGUARD® HG-702 TurbiPlus®

Water Quality Analyzer & Controller

User Manual

Document ID HG702TPUM1.3

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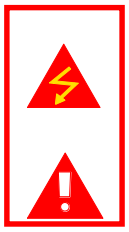
1 General Safety Precautions



This section presents important information intended to ensure safe and effective use of this product.

Read the following carefully before handling the product. These warnings and cautions must be followed carefully to avoid injury to yourself or damage to equipment.

Warning: Only properly trained and licensed electricians should attempt to wire or service the electronic components of the analyzer/controller.	Attention! Seuls des électriciens qualifiés ayant reçu la formation adéquate peuvent entreprendre le branchement, l'entretien ou la réparation des composants électroniques de l'analyseur/du contrôleur.
There is an Electrical Shock Hazard when servicing this system.	Il existe un risque de choc électrique lors de l'entretien de ce système.
Always verify that all electrical power source(s) are off before opening the analyzer/controller unit or attempting to service electronic components or wiring.	Ayez soin de toujours vérifier que la ou les source(s) d'alimentation électrique est ou sont bien déconnectée(s) avant d'ouvrir l'unité ou d'entreprendre toute opération de service technique et tout branchement des composants électroniques.
Caution: Extreme caution should be used when installing, operating, and maintaining the HYDROGUARD® Analyzer. Only properly trained technicians are authorized to install and maintain the analyzer/controller.	Attention! Il y a lieu d'agir avec une extrême prudence lors de l'installation, de la mise en œuvre et de la maintenance du contrôleur HYDROGUARD®. Seuls des techniciens dûment formés à cet effet sont autorisés à effectuer l'installation et la maintenance de l'analyseur/du contrôleur.
Only properly trained and licensed operators should attempt to make any changes to chemical dosing levels.	Seuls des opérateurs qualifiés ayant reçu la formation adéquate sont habilités à modifier les dosages des produits chimiques utilisés.
Always follow local health and safety regulations when performing any service on the analyzer/controller unit or when changing chemical dosing settings.	Conformez-vous sans exception aux consignes locales de santé et de sécurité lorsque vous effectuez toute opération technique sur l'analyseur/le contrôleur, ou lorsque vous modifiez les paramètres de dosages chimiques.
The main power supply may be connected to either 110-120 or 220-240VAC 50/60Hz. Switching between voltages is accomplished by changing two (2) jumpers located above the main power connection, to the left of the transformer. For 110-120VAC, a 1amp fuse should be use; for 220-240VAC, a 0.5amp fuse should be used. These changes must be completed prior to wiring.	L'alimentation générale peut être branchée sur 110-120 ou sur 220-240VAC 50/60Hz. Pour basculer d'une tension à l'autre, il suffit de changer les deux (2) cavaliers situés au-dessus de la principale connexion électrique, à gauche du transformateur. Une tension à 110-120VAC requiert un fusible de 1 Amp. ; une tension à 220-240VAC requiert un fusible de 0,5 Amp. Ces modifications doivent être accomplies avant le branchement électrique.

Caution: Before connecting to a power source, confirm that both jumpers are located on the correct voltage and that the appropriate fuse is in place.	Attention! Avant de relier l'appareil à une quelconque alimentation électrique, vérifiez que les deux cavaliers sont situés sur les valeurs correctes de tension et que c'est le bon fusible qui est en place.
Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.	Chaque connexion relais est limitée à 4 Amp. afin d'éviter toute surchauffe. Même si les relais affichent éventuellement une valeur supérieure, ils ne se connecteront pas à un élément dépassant 4 Amp.
All electrical connections should comply with National Electrical Code (NEC) and all local regulations.	Tous les branchements électriques doivent être conformes au Code Electrique National (NEC – *National Electrical Code*) ainsi qu'à toutes les consignes locales.
<u>Mixing reagents:</u>	<u>Mélanges réactifs:</u>
Caution: Use protective gear as recommended in MSDS.	Attention! Utilisez l'équipement de protection préconisé dans la fiche de données de sécurité (MSDS).
Caution: Do not use chemicals that reduce the surface tension. When using hydrochloric acid, observe all safety regulations.	Attention! N'utilisez pas de produits chimiques susceptibles de réduire la tension superficielle. Lors de l'utilisation d'acide chlorhydrique, appliquez scrupuleusement toutes les consignes pertinentes.
Caution: HYDROGUARD's control board unit should not be opened except for initial installation and troubleshooting, and should only be opened by a trained and approved technician.	Attention! Le tableau de commandes de l'HYDROGUARD ne doit en aucun cas être ouvert si ce n'est lors de l'installation initiale et en cas de dépannage – auquel cas son ouverture ne doit être effectuée que par un technicien ayant reçu la formation adéquate et dûment habilité.

2 Preface

2.1 Intended Use

This manual is for qualified and trained service technicians who will install and service the HYDROGUARD HG-702 TurbiPlus Water Quality Analyzer. It provides instructions on how to install the HYDROGUARD system, how to integrate it with external chemical dosing systems and how to calibrate, operate and maintain the system.

2.2 Overview of Chapters

This document is functionally divided into chapters according to the various steps involved in installing and operating the HYDROGUARD system.

Chapter 1: General Safety Precautions	This section presents important information intended to ensure safe and effective use of this product.
Chapter 2: Preface	Intended use of the manual and safety issues
Chapter 3: Controller Overview	General description of how water quality is maintained and how HYDROGUARD automatically monitors and controls
Chapter 4: Installation	Instructs how to install HYDROGUARD and how to integrate it with water quality systems
Chapter 5: First Time Set-up	Instructs how to configure, calibrate, and operate the HYDROGUARD system immediately after it is installed
Chapter 6: Routine Operation and Maintenance	Instructs how to respond to alarms and troubleshooting issues
Chapter 7: Optional features	Describes some optional components that may be installed on the controller or added later
Chapter 8: Relays & Closed-Loop Control	Lists and describes HYDROGUARD's operational components
Chapter 9: Setting Proportional Control	Describes how HYDROGUARD implements proportional monitoring and control and instructs how to configure it in various environments

Chapter 10: Technical Specifications	Includes information about dimensions, electrical systems, relays, measurement of chlorine, turbidity and pH, etc.

3 Overview

The HYDROGUARD HG-702 TurbiPlus Water Quality Analyzer & Controller continuously monitors and automatically controls chemical levels in process water and potable water applications. HYDROGUARD performs automated analysis of free and/or total chlorine, turbidity, pH, ORP (redox), temperature, conductivity and flow rate, administering chemicals as required, according to the results of these tests.

3.1 The HYDROGUARD Solution

Various methods have been developed over the years to monitor the concentration and balance of chemicals used in water treatment. HYDROGUARD measures free and/or total chlorine levels with a digital photometer, which has many advantages over other types of sensors. Digital photometer testing is completely objective. It is not dependent on lighting conditions or the operator's eyesight, and is far more accurate. It does not require frequent calibration and is compatible with all types of disinfectant systems. HYDROGUARD performs colorimetric testing in a closed reading cell. It is the only system that automatically and accurately measures free chlorine using small amounts of reagent.

HYDROGUARD provides a turbidity measurement in NTU (Nephelometric Turbidity Units). This provides a consistently objective evaluation of the overall water quality. High turbidity may be a result of poor filtration or unbalanced water chemistry. The turbidity value will provide an indication that one of these conditions exists and that action is required to improve the water quality. In many cases the turbidity can be reduced by adding a flocculent to the filter which will improve filtration. A turbidity relay is included in the controller and will operate when turbidity is above the set point. This may be connected to a flocculent dosing pump or other equipment used to reduce turbidity, providing an automatic response and maintaining clear water without manual intervention. Likewise, if the turbidity ever exceeds a pre-set limit, the controller will set off an alarm indicating that attention is required.

Once installed and calibrated, HYDROGUARD is fully automatic. It will monitor and can control dosing systems directly, releasing the proper quantity of chemicals based on frequent automatic measurements. HYDROGUARD is simple to use. Its straight-forward control panel and parameters menu make chemical balance control an easy task. All basic information can be viewed at a glance, and changing settings is as simple as scrolling through the menu and adjusting the current settings.

3.2 Measurements and Features

The HYDROGUARD HG-702 TurbiPlus can be configured to measure any combination of the following water quality parameters:

- Free chlorine
- Total chlorine
- Both free chlorine and total chlorine
- Turbidity

Optional measurements:

- Temperature
- Conductivity
- pH
- ORP (redox)
- Temperature
- Flow rate

Optional communication protocol

- Modbus Protocol
- Blue I Protocol

Several communication options are also available:

- Internal 4 to 20 mA outputs (up to 6 channels)
- Wireless modem
- Ethernet
- Modbus

3.2.1 Wireless Management Package*

An advanced and unique HYDROGUARD option is the wireless modem which provides web-based monitoring of up to 5 analyzers. This cellular communicator collects HYDROGUARD's alarms and readings and transmits them to a web-based application server. The information is easily accessed via the Internet or mobile device.

*The wireless modem is an optional module.

Note: Not all cellular companies support this wireless modem. Please contact Blue I Water Technologies or your supplier for details. See the supplemental manual for instructions on installing and using the modem.

3.3 System Components

HYDROGUARD has two primary units: the analyzing unit and the control unit.

The **analyzing unit** performs the actual measurements. It contains the following components:

Colorimetric Assembly Unit – A closed cell that measures free and/or total chlorine levels using DPD reagents and a digital photometer, and measures turbidity levels using a nephelometer.

Sampling Cell – Contains the sensors, including the pH, Redox (ORP) and temperature sensors.

Reagent Bottles – Contains the reagents used by the colorimeter to measure chlorine levels in the water.

Reagent Pumps and Solenoid Valve – Accurately controls the flow of water and reagents into the colorimeter, making every measurement as accurate as possible.

The **control unit** includes all electronics, the user interface and the software that controls the measurements performed in the analyzing unit. It includes the following components:

I/O Module (Input/Output) – Providing power to the analyzer and containing the dry-contact relays for direct control of external dosing systems.

Control Panel – Calculates the measurement results and determines the required chemical dosing to maintain an appropriate chemical balance in closed-loop systems. The control panel also provides data to external communication devices such as the 4-20 mA outputs, wireless modem or Modbus communication.

Keyboard Panel – Mounted on the cover of the control module, the keyboard panel functions as HYDROGUARD's user interface. This control panel displays current measurements and indicates alarms. All settings and adjustments are performed through the control panel.

Colorimeter Card – Controls the colorimeter and associated components, such as the reagent pumps and solenoid valve. It accurately calculates the chlorine and turbidity levels.

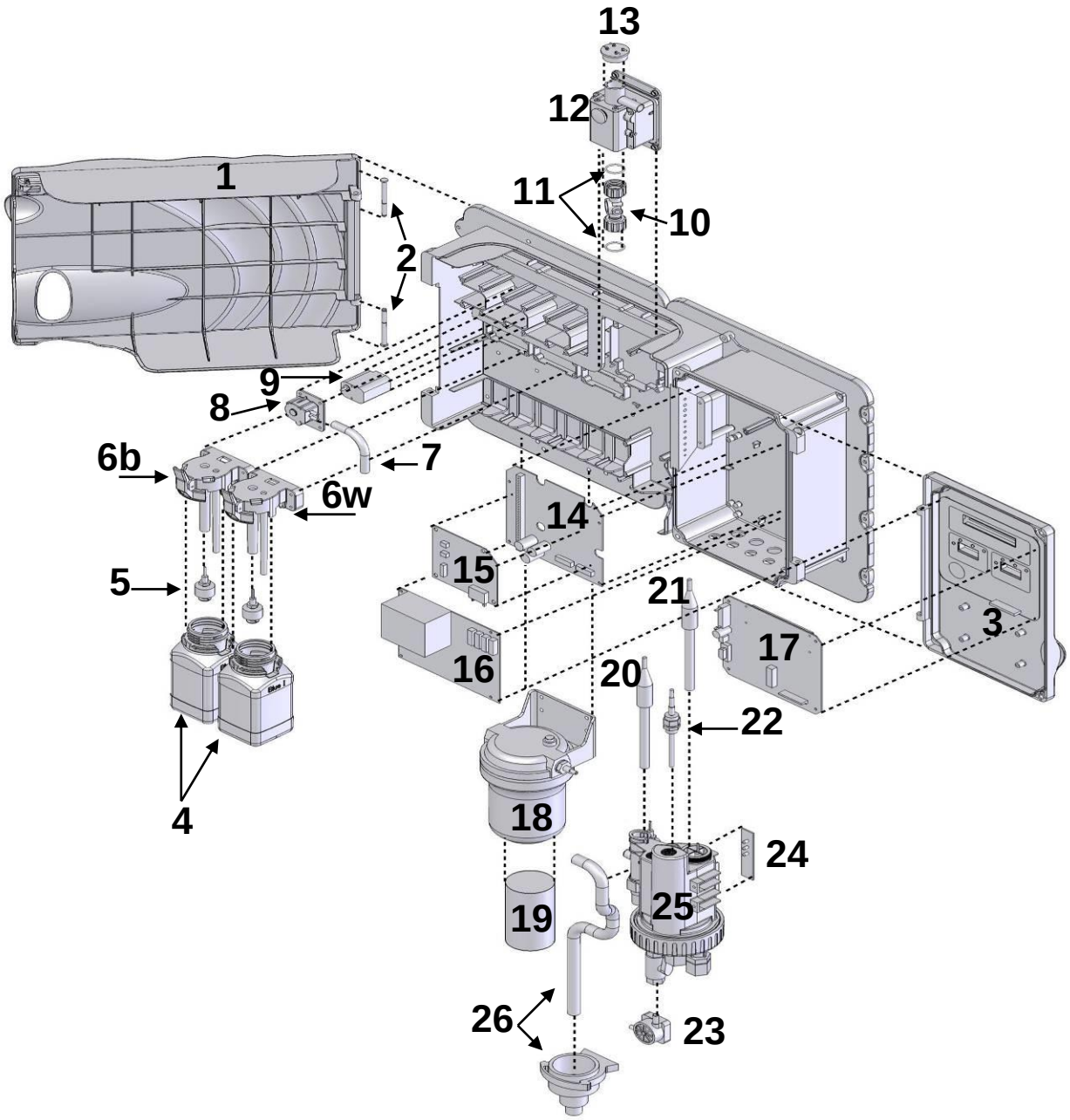
pH, Redox, Temp Module* – Receives signals from the pH, redox, and temperature probes.

Internal 4-20 Input Module* – Contains connections for turbidity and conductivity meter and a 4-20 flow meter.

Internal 4-20 Output Module* – Provides up to six 4-20 mA outputs for any measured variable.

*Optional module

Figure 1: HYDROGUARD HG-702 TurbiPlus Components



Illustrated Part Number	Part Description
1	Lab Door
2	Door Axis
3	Door +Touch panel HG-702
4	DPD1 Reagent Set
not shown	DPD3 Reagent Set
5	Level/float Switch
6b	Bottle Holder - blue
6w	Bottle Holder - white
6r	Bottle Holder - red
7	Pump Tubes
8	Pump Head
9	Pump Motor
not shown	Peristaltic Pump
10	Solenoid Valve
11	Solenoid O-rings
12	Colorimeter Assembly Unit for TurbiPlus
13	Injection Module
14	Colorimeter Card
15	AMP/pH/TEMP /REDOX CARD
16	I/O Module
17	Control Panel Module HG-702 FAT for TurbiPlus*
17	Control Panel Module HG-702 FOT for TurbiPlus *
18	Pre-filter Assembly
19	Cartridge filter
not shown	Pressure reducer gage
20	pH Probe
21	ORP Probe
22	Temp Probe (PT-100)
23	Rotating Flow Switch
24	LED Module
25	Pressurized Sampling Cell
26	Colorimeter Drain
27	Colorimeter Drain Funnel

4 Installation

4.1 Selecting a Location

HYDROGUARD installation begins with manual installation and connecting the unit to the system that it controls, as described in this chapter. Once physically installed, sensors and reagents must be inserted into the unit and the control system must be started and calibrated, as described in Chapter 5, First Time Operation and Calibration. HYDROGUARD should operate for several days in order to be properly tuned to its specific environment. Additional periodic modification, calibration, and maintenance are required after HYDROGUARD has been operating on a regular basis. This is described in Chapter 6, Routine Operation and Maintenance.

Convenient access – HYDROGUARD should be installed where it can easily be viewed and operated.

Dry area – HYDROGUARD is operated by electricity and includes electronic circuitry that is susceptible to short-circuiting and/or corrosion when exposed to water or high ambient moisture levels; therefore, the unit should be installed in a dry area.

Away from chemicals – Many water treatment chemicals can be corrosive to HYDROGUARD's electronic circuitry. It is highly recommended that the unit is not installed adjacent to a storage area for chemicals or the dosing systems themselves.

Minimal distance from supply pipe – The water sampling line that is connected to the main pipe which feeds the HYDROGUARD should be as short as possible. A long sample line creates unnecessary delay between supply, measurement, analysis and chemical dosing.

Drainage – HYDROGUARD's location should allow the colorimeter drain outlet sufficient grade for gravity flow, without creating an obstacle (e.g., no pipe across walkway). The sampling cell may be pressurized to allow for return to the system under pressure.

Freezing and changing temperatures – The analyzer should be installed in a location that is not susceptible to freezing temperatures. This is because reagents can freeze, preventing accurate readings (even when thawed); and parts may be damaged due to expansion when ice forms. Avoid installing in a location that is exposed to extreme temperature fluctuations; sudden water temperature changes can affect readings.

4.2 Site Requirements and Installation

The HYDROGUARD assembly is wall-mounted. It should be located on a wall where operators and service technicians can easily access it for normal operation and maintenance. It is also advisable to install it where the operators can easily view the readings and alarms. The complete unit with all connections weighs 24.3 lbs (11 kg), so it must be mounted securely on a stable wall.

The HYDROGUARD unit measures as follows (W x H x D):

Controller: 26.4" x13" x 5.1" (67 cm x 33 cm x 13 cm).

Mounting board: 31.5" x21.7" x 0.2" (80 cm x 55 cm x 0.5 cm).

The base of the controller should be mounted at least 24" (61 cm) above the floor (preferably at eye level).

Note: During disassembly, be sure to retain all hardware for use during reassembly. Upgrade and replacement kits may re-use some original components.

4.2.1 Mechanical Installation Requirements

The HYDROGUARD unit and its mounting panel are not shipped with mounting screws or anchors. The installer must provide screws and anchors that can hold the weight of the HYDROGUARD unit, mounting panel, intake filter and electrical outlets and junction boxes. The screws and anchors must be compatible with the wall where it will be installed.

4.2.2 Mechanical Installation

The following procedure instructs how to install the HYDROGUARD unit.

1. HYDROGUARD is shipped pre-mounted on a mounting panel, along with a water filter.
2. Attach the water filter before mounting the panel on the wall.

The mounting panel includes four screw holes, one in each corner.

3. Determine the location on the wall for each hole on the HYDROGUARD unit or on the mounting panel; drill the holes and insert screw anchors.

Figure 2: Mounting HYDROGUARD on the Wall

4. Place a 5/16” (8 mm) screw in each hole and **two metal washers (supplied with the unit)** on each screw behind the mounting panel, so that they come between the mounting panel and the wall. Screw the panel to the wall.

Note: The HG-702 TurbiPlus must be leveled in order to achieve proper operation.

4.3 Plumbing Requirements and Installation

4.3.1 Water Supply

HYDROGUARD requires a pressurized water supply to the sampling cell. An isolating valve must be installed between the main line and the pipe (or tube) to the HYDROGUARD filter.

The distance from the main pipe to the HYDROGUARD should be as short as possible, in order to minimize delay time between the water being sampled and HYDROGUARD’s measurement.

Minimum inlet pressure should be 4.4 psi (0.3 bar) and should not exceed 14.5 psi (1 bar) using a pressure reducer attached to the pre-filter outlet (Figure 3).

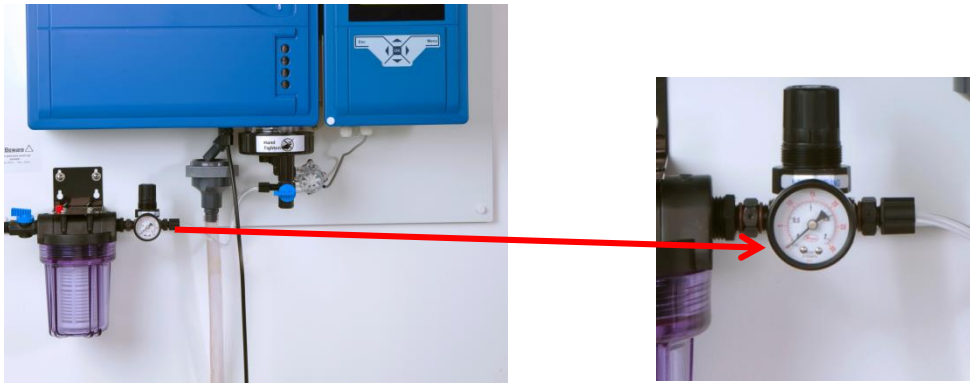


Figure 3: Pressure Reducer

4.3.2 Colorimeter Drainage

A gravity drainage connection is required for the water draining out from the colorimeter. A pressurized, vacuum, or gravity connection is required from the outlet of the sampling cell to return water from the sampling cell to the water supply. The length of the colorimeter drain line should be as short as possible and must have a constant downward slope to prevent backflow.

The sampling cell may be pressurized up to 14.5 psi (1 bar); if the sampling cell drain is connected to vacuum, the inlet pressure must be at least 7 psi (0.5 bar) greater than the drain vacuum. A drain cap is located on the colorimeter outlet to prevent backflow into the colorimeter if the drain line is blocked. A ½" NPT fitting is supplied for the colorimeter drain connection and a ¼" FNPT fitting is supplied for the sampling cell drain connection.

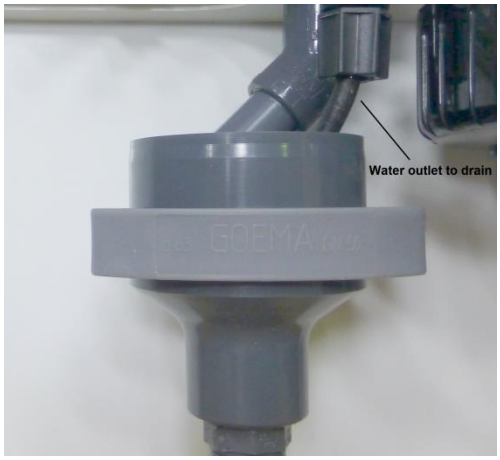


Figure 4: Colorimeter Drainage

Note
The HYDROGUARD colorimeter drains water at zero (0) pressure. The drainage pipe should be as straight as possible. It should have a constant downward slope and should not have any bends where water flow can be restricted. If the colorimeter drains to a bucket or basin, the end of the drainage pipe should terminate above the bucket or basin rim.

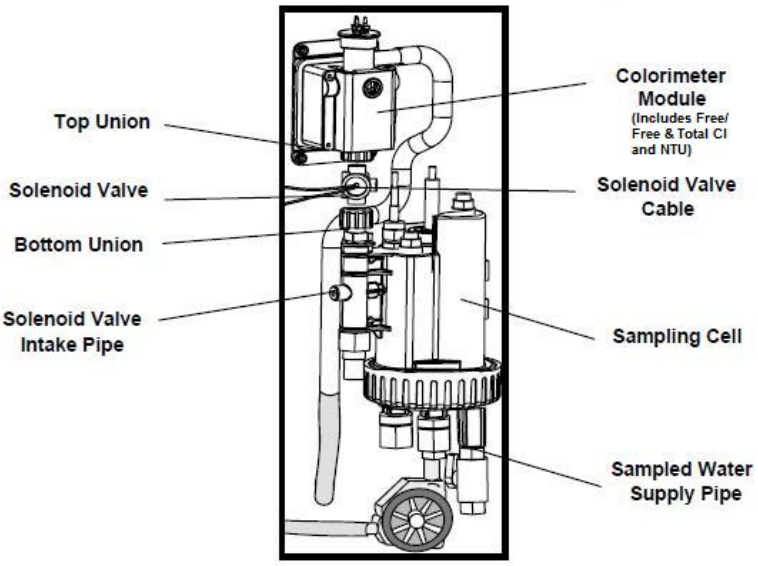


Figure 5: Sampling Cell and Colorimeter Components

4.4 Electrical Requirements and Installation

HYDROGUARD requires a 100-120 or 220-240 VAC, 50/60 Hz electrical power source on a separate 16A circuit in the facility's electrical board. The main HYDROGUARD power supply should be connected to a non-dependent power supply, so that the unit remains powered constantly. The active relays should be connected to a dependent power supply (interlocked power supply).

4.4.1 Connecting the Main Electrical Power

Note

HYDROGUARD HG-702 TurbiPlus default configuration is 100-120VAC unless 220-240VAC configuration was ordered.

The main power supply may be connected to either 110-120 or 220-240VAC 50/60Hz. Switching between voltages is accomplished by changing two (2) jumpers located above the main power connection, to the left of the transformer. For 110-120VAC, a 1amp fuse should be used; for 220-240VAC, a 0.5amp fuse should be used. These changes must be completed prior to wiring.

Caution:

Before making a connection to a power source, confirm that both jumpers are located on the correct voltage and that the appropriate fuse is in place.

1. Verify that the power switch or circuit breaker to the non-dependent power source is off.
2. Connect the line (live) wire to the electronic relay card connector marked **Line**.
3. Connect the neutral wire to the electronic relay card connector marked **Neutral**.

4. Connect the earth wire to the I/O card connector marked **Ground**.
5. Continue with the other electrical connections.
6. Turn on electrical power only **after** all electrical connections have been completed.

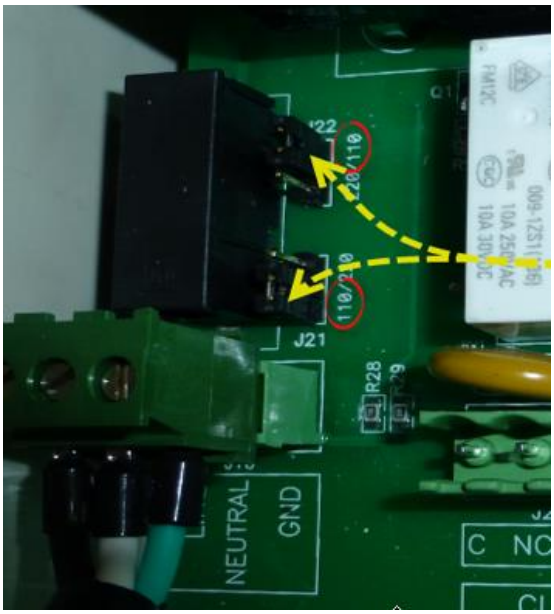


Figure 6: 110-120VAC set up

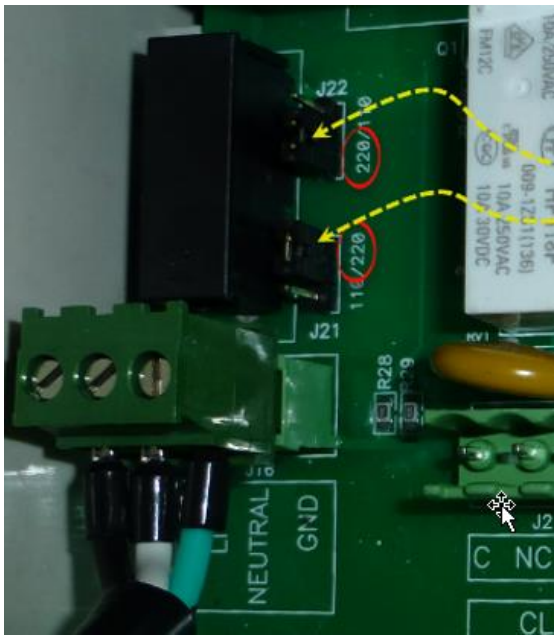


Figure 7: 210-220VAC set up

For information on wiring and using the relays as dry contact or for control, see section 7.8 below: Chlorine Shock Mode.

4.4.2 Input Switches

Flow input switch terminal blocks on the I/O module allow for three input switches to be connected to the system as additional layers of security against accidental chemical additions when there is no flow. If a connection is expected but not detected at each input, the analyzer/controller will indicate an alarm and will close all relays (and open the alarm relay). Therefore, if a safety switch (flow, level, etc.) will not be installed, a fixed connection (jumper wire) is required to allow the controller to operate.

Two flow switches (included) and one flow meter (not included) may be connected:

- Internal Flow Switch: Flow switch connected to the analyzer's sampling cell. Supports both 2- and 3-wire flow switches.
    - If a 2-wire switch is used, it should be connected to the "In" and "Gnd" connections. If a 3-wire switch is used, the "VCC" connection will also be used.
- External Flow Switch: Connection for an external 2-wire flow switch.
    - If an external switch is not connected, the Internal Flow Switch must be installed for the analyzer to operate properly.
- Flow Meter: Connection for 2- or 3-wire flow meter. The analyzer will not display flow meter readings on the LCD display until "flow sensor" is turned ON in the Technician Menu (See section 5.3.5); Therefore, no jumper is required if a meter is not installed.

Caution

Electrical connections depicted in this section are ONLY recommendations. All electrical connections should comply with National Electrical Code (NEC) and all local regulations.

5 First Time Operation and Calibration

5.1 Installing Additional Sensors

Install all additional sensors and meters and connect to the main system of the HYDROGUARD HG-702 TurbiPlus, following the instructions for each sensor as follows.

5.1.1 pH, ORP (Redox) and Temperature Measurements

5.1.1.1 Installation

If the HYDROGUARD system was ordered with these components some steps in this process will have been completed in the factory and may be skipped.

Required Components

- pH, ORP, Temp Module (electronics card)
- 150 mm flat cable
- pH probe
- ORP (Redox) probe
- Temperature probe
- Connectors for temperature probe

Note

The system may be operated with only pH or only ORP but must always have the temperature probe as this provides additional grounding to ensure reliable pH and ORP measurements.

The following procedure describes how to install the ORP (Redox) and pH sensors in the HYDROGUARD unit. The installation of all the sensors in the sampling cell is similar, except for the connecting wires.

Caution

Make sure the pH and ORP (Redox) sensors have plastic or rubber plugs covering their ends. Use another sensor if the plug of any sensor is missing or has fallen off.

Make sure to connect the appropriate wire to the appropriate sensors. Labels are located on the wires near the probe connection and on the connection on the pH, Redox, Temp Module.

1) Turn off all power and water supplies to the analyzer.

Install the pH, ORP, Temp module (electronics card) in the control module on the top left (above the colorimeter module, if present) using the 4 supplied screws.

Connect the flat cable to the pH, ORP and Temp module to an open connector on the I/O module.

Install the temperature probe:

a. Thread the 3/8” compression connector into the back of the sampling cell.

b. Place the probe into the connector and secure in place.

c. Route the temperature probe wires into the electronics box and connect to the pH, ORP and Temp module following the color codes listed on the module.

Install the pH and/or ORP probes:

a. Remove the sensor from its packing box.

b. Remove the plastic cover or plug from the end of the sensor and drain the solution from the tube. Keep the plastic cover in a safe place for winterizing or storage of probes.

c. Hold the sensor by its metal connector, with the glass tube pointing down.

d. Insert the sensor into the top of the transparent sampling cell and thread in securely. DO NOT OVERTIGHTEN.

e. Route the pH and/or ORP cables to the electronics box and connect to the pH, ORP and Temp module.

f. Connect each cable to the appropriate sensor.

Repeat step 5 for additional sensors.

If only one sensor is installed:

a. Install a jumper between the inputs for the missing probe.

b. In the menu, set the low and high alarm limits at the minimum and maximum values respectively to prevent a false alarm for a measurement that is not connected.

Switch the HYDROGUARD ON and verify that pH and or ORP readings appear on the display. In some analyzers, this may need to be turned on in the Technician Menu.

Observe the pH and ORP (Redox) levels and wait several minutes until both readings stabilize. If either one or both indicators do not display a proper reading or are not stable, confirm proper installation and then see the Troubleshooting section (6.6).

5.2 Installing Reagents

The following procedure describes how to mix the DPD indicator reagents and install the reagent bottles:

Note

Once mixed, the reagents have a shelf-life of 2 months, and will lose accuracy if used beyond this time limit.

1. Open the HYDROGUARD Reagent Set. The following items should be in the box:
    A. Chlorine indicator and buffer mixing instructions.
    B. 1 X 600 ml bottle of chlorine buffer with a **white** label.
    C. 1 X 600 ml bottle of chlorine indicator fluid with a **blue** label.
    D. 1 X small bottle of chlorine indicator salt with a **white** label.

Figure 8: Reagent Bottle Labels

2. Remove the caps and foil protection for the **indicator fluid** and small **indicator salt**.
3. Empty the contents of the indicator salt into the bottle of indicator fluid.
4. Place the cap on the bottle of chlorine indicator fluid and close tightly.
5. Turn the bottle upside-down **slowly and carefully**, so that no bubbles form in the fluid.
6. Repeat five (5) times until all the indicator salt is dissolved in the indicator fluid. See illustration below.

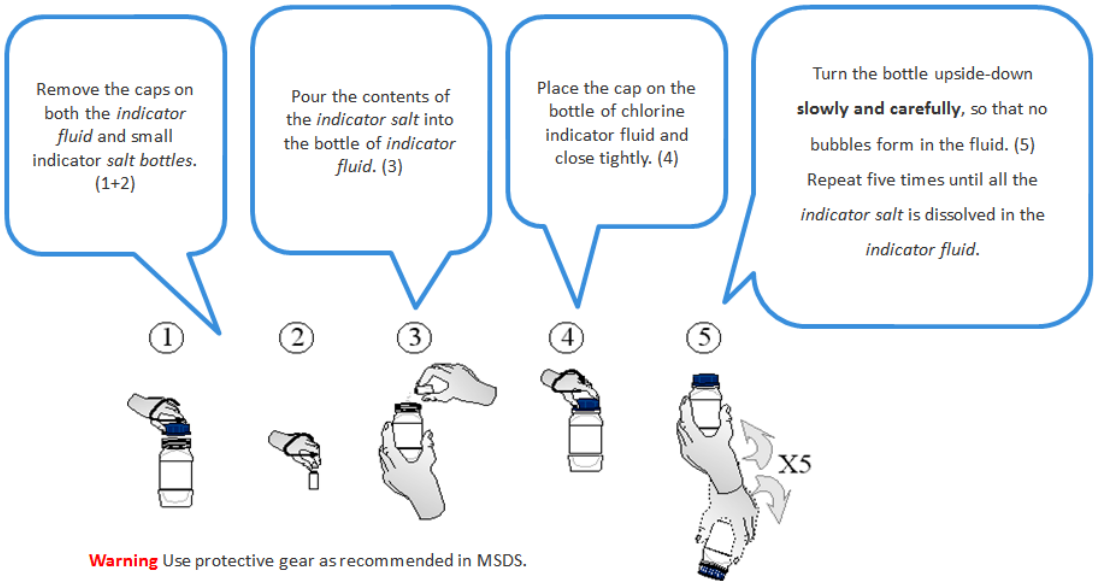

Remove the caps on both the *indicator fluid* and small indicator *salt bottles*. (1+2)
Pour the contents of the *indicator salt* into the bottle of *indicator fluid*. (3)
Place the cap on the bottle of chlorine indicator fluid and close tightly. (4)
Turn the bottle upside-down **slowly and carefully**, so that no bubbles form in the fluid. (5) Repeat five times until all the *indicator salt* is dissolved in the *indicator fluid*.
1
2
3
4
5
X5
Warning Use protective gear as recommended in MSDS.

Figure 9: Mixing Indicator Salt into Indicator Fluid

7. Place the reagent bottles in position:

   A. Remove the cap from the reagent bottles.

   B. Place the opening of the reagent bottle below the bottle siphons. (Match the bottle to its correct holder: blue in the blue holder; white in the white holder; and if measuring Total Cl, the red bottle in the red holder. See Figure 11.)

   C. Lift the bottle up until the opening reaches the bottle siphon cap.

   D. Push the lever above the siphon cover away from you, and push the reagent bottle up.

   E. Push the bottom of the bottle into position.

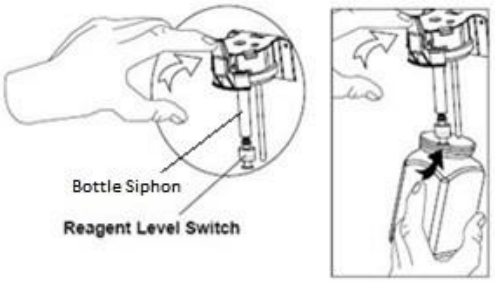


Figure 10: Reagent Bottles and Siphon Caps

Caution:

Do not refill the reagent bottles.

Do not mix or add reagent from other bottles.

Only use original Blue I Water Technologies reagents.

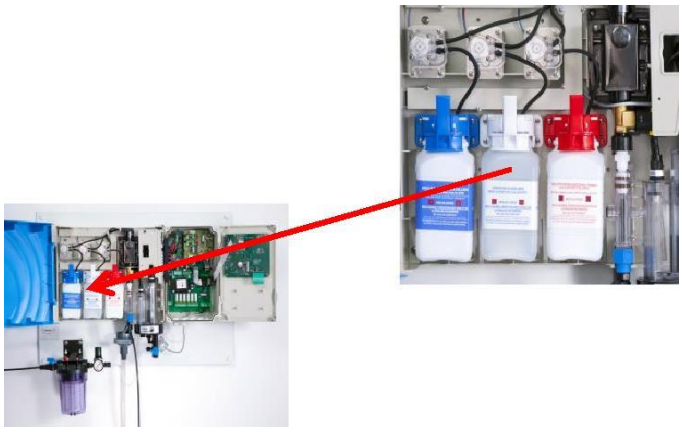


Figure 11: Reagent Bottles in Position

8. Prime the reagent pumps:
    a) Lift the reagent injector from the colorimeter
    b) Press Menu on the control panel keypad until the Reagent Pump menu appears
    c) Press OK
    d) Enter password (123 is default) using the up and down arrows
    e) Press OK (OFF will appear on top line)
    f) Press OK again (OFF will appear on the top and bottom lines)
    g) Press UP to turn the reagent pumps ON
    h) Press OK when the water flowing from the colorimeter has a red tint or when reagent drops are being formed at the needle tips
    i) Press Esc twice (2x) to return to the main screen
    j) Replace the reagent injector into its position

Note: This procedure is done to eliminate air from the reagent tubes.

5.3 First Time Menu Setup

This section describes how to configure the settings (set points, alarms, and calibrations) using the HYDROGUARD control panel.

Caution
HYDROGUARD's control panel unit should not be opened except for initial installation and troubleshooting and should only be opened by a trained and approved technician.

5.3.1 HYDROGUARD Control Panel

The HYDROGUARD control panel, Figure 12, is a simple, intuitive interface for monitoring and controlling water quality with the following components:

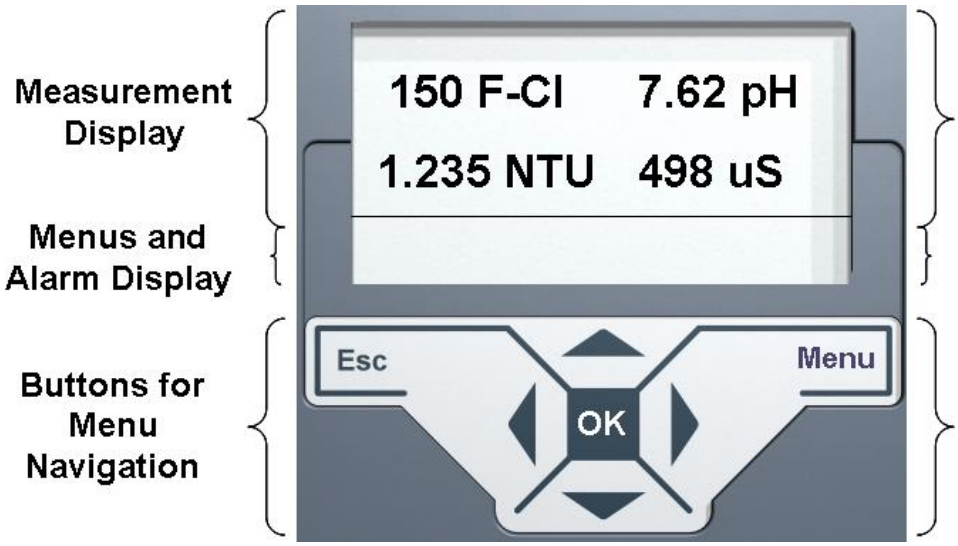


Figure 12: HYDROGUARD Control Panel

Table 1 - Control panel structure

LCD Display	At the top of the control panel is an LCD display which shows all measured variables at top and all Alarms and Menus at bottom
Menu Button	Enters and scrolls through the menus
Esc	Moves one level back in the menu without making changes
OK	Enters setting change mode and accepts setting change
Up/Down Arrows	Changes value up or down

When an alarm is issued, the bottom row of the LCD displays the alarm.

5.3.2 Menus

HYDROGUARD has two menu options: Operator and Technician. The Operator Menu includes settings that may be controlled by on-site operators. The Technician Menu includes settings and calibrations that should be restricted to specially trained HYDROGUARD maintenance technicians. Each menu has a separate password.

5.3.3 Operator Menu

Table 2 - Operator Menu Functions and Descriptions

Function Name	Description
Shock Chlorination	Activate Chlorination according to "Cl shock set point"
Menu Relays	Manual activation of Relays
Reagent pump	Manual activation of Reagent Pumps
Cl set point1	Controls Cl **relay 1** – On/Off or Proportional
Cl shock set point	Controls Cl relay according to the set point level for a period of time
Cl set point2	Controls Cl **relay 2** – On/Off only
F-Cl calibrated to sensor value was	Most recent calibration & sensor value at calibration for troubleshooting purposes
Cl low alarm	Initiates an alarm when Cl is below value
Cl high alarm	Initiates an alarm when Cl is above value
Cl interval	Time between Cl measurements
pH set point*	Controls pH **relay 3** – On/Off or Proportional
pH 7 calibrated to* sensor value was	Most recent calibration & sensor value at calibration for troubleshooting purposes
pH 4,10 calibrated to* sensor value was	Most recent calibration & sensor value at calibration for troubleshooting purposes
pH low alarm*	Initiates an alarm when pH is below value
pH high alarm*	Initiates an alarm when pH is above value
ORP set point1*	ORP set point for emergency mode only
ORP calibrated to* sensor value was	Most recent calibration & sensor value at calibration for troubleshooting purposes
ORP low alarm*	Initiates an alarm when ORP is below value
ORP high alarm*	Initiates an alarm when ORP is above value & opens Cl relays 1 & 2
Temp calibrated to* sensor value was	Most recent calibration & sensor value at calibration for troubleshooting purposes
Temp low alarm*	Initiates an alarm when Temp is below value
Temp high alarm*	Initiates an alarm when Temp is above value
Turbidity set point*	Controls Turbidity **relay 4** – optional module
NTUl calibrated to sensor value was	Most recent low NTU & sensor value at calibration for troubleshooting purposes
NTUh calibrated to sensor value was	Most recent high NTU & sensor value at calibration for troubleshooting purposes
Turbidity high alarm	Initiates an alarm when Turbidity is above value
Conduc. set point*	Controls Conductivity **relay 6** (when conductivity is available)
Conduc. calibrated to* sensor value was	Most recent conductivity & sensor value at calibration for troubleshooting purposes
Conduc. low alarm*	Initiates an alarm when Conductivity is below value
Conduc high alarm*	Initiates an alarm when Conductivity is above value
Conduc active time*	The activations duration of the coagulants pump
Alarm delay	Time delay before alarm **relay 5** closes
Flow low limit*	Low limit for external flow meter
Flow k-factor*	k-factor for external flow meter
Total Alkalinity	Manually entered for Langelier Index
Total Hardness	Manually entered for Langelier Index
TDS	Manually entered for Langelier Index
T-Cl calibrated to* sensor value was	Most recent calibration & sensor value at calibration for troubleshooting purposes
Total Cl high alarm*	Initiates an alarm when Total Cl is above value
Comb. Cl high alarm*	Initiates an alarm when combined (Free & total) Cl is above value

Function Name	Description
ORP Emergency mode*	Allows ORP mode to be used in case there is a Cl measurement problem If a problem occurs with the colorimeter (unclean cell, stuck piston, communication error), or the customer runs out of reagents, the analyzer may be temporarily operated in ORP Emergency Mode. This mode must be started manually, by scrolling to the ORP Emergency Mode Menu, entering the password, and switching the mode to ON. If no colorimeter problem is present, the analyzer will not allow this mode to be entered. When in ORP Emergency Mode, the ORP set point will be used to control Relay 1 (primary Cl relay). When the problem is corrected, the analyzer will automatically resume operation in normal mode. If not corrected after 3.5 days, the analyzer will close Relay 1.
Language	Choice of language
SYSTEM RESET	On/Off for controller power – a safer option than turning it on and off. (This operation does not reset analyzer settings.)

* Optional features

Table 3 - Operator Menu Functions - Minimum and Maximum Values

Function Name	Min Value	Max Value	Default	Units
Shock Chlorination	OFF	ON	OFF	--
Menu Relays	OFF	ON	OFF	--
Reagent pump	OFF	ON	OFF	--
Cl set point1	0	9.99	1.5	ppm
Cl shock set point Cl shock duration	0 0:00	9.99 24:00	1.5 2:00	ppm hours
Cl set point2	0	9.99	1.5	ppm
F-Cl calibrated to sensor value was	0.1	9.99	n/a	ppm
Cl low alarm	0	9.99	0.5	ppm
Cl high alarm	0	10	2.0	ppm
Cl interval	2:00	10:00	2:00	min
pH set point*	4.0	14.0	7.40	--
pH 7 calibrated to* sensor value was	4.0	14.0	n/a	--
pH low alarm*	4.0	14.0	6.90	--
pH high alarm*	7.0	13.9	7.80	--
pH 4,10 calibrated to* sensor value was	4.0	10.0	7.40	--
ORP set point1*	0	1200	600	mV
ORP calibrated to* sensor value was	0	1200	n/a	mV
ORP low alarm*	0	1200	600	mV
ORP high alarm*	0	1200	850	mV
Temp calibrated to* sensor value was	1/34	49.9 /121.9	n/a	^{0}C / ^{0}F
Temp low alarm*	1/34	49.9 /121.9	18^{0}C	^{0}C / ^{0}F
Temp high alarm*	1/34	49.9 /121.9	50^{0}C	^{0}C / ^{0}F
Turbidity set point	0	200	0.60	NTU
NTUl calibrated to sensor value was	0	1	n/a	NTU
NTUh calibrated to sensor value was	0	1	n/a	NTU
Turbidity high alarm	0	99.9	99.9	NTU

Function Name	Min Value	Max Value	Default	Units
Conduc. set point*	1	10000	1000	us
Conduc. calibrated to* sensor value was	1	5000	740	us
Conduc. low alarm*	0	5000	0	us
Conduc high alarm*	1	5000	4900	us
Conduc active Time*	0	180	1	min
Alarm delay	0	10	0:30	min
Flow low limit*	0	200 or 999	0 = off	M^3/hr or GPM
Flow k-factor*	0.001	655	0.01	--
Total Alkalinity	0	600	0	ppm
Total Hardness	0	600	0	ppm
TDS	0	5000	0	ppm
T-Cl calibrated to* sensor value was	0.01	9.99	1.50	ppm
Total Cl high alarm*	0	9.99	3.5	ppm
Comb. Cl high alarm*	0	9.99	2.5	ppm
ORP Emergency mode*	OFF	ON	OFF	--
Language	--	--	Allows choice of language	--
SYSTEM RESET	n/a	n/a	n/a	--

* Optional features

Note

In a FOT (Free or Total) model, when T-CL is selected, F-CL will not appear on the display, and vice versa.

5.3.4 Configuring Settings in the Operator Menu

Each of the parameters in the Operator Menu is configured in the same way. The following procedure describes how to configure a typical setting:

1) Locating the desired parameter in the menu:

   Press Menu until the desired parameter name appears in the LCD display.

2) Press OK. “Enter Password 100” will appear in the LCD display.

3) Enter the operator password (the technician password will also be accepted).

4) Press the up arrow or down arrows until the password number is reached.

Note

Holding down the Menu key while pressing up or down will advance the first digit. Holding down the up or down keys will proceed through the numbers more quickly.

The factory-set operator password is 123. The operator password can only be changed by entering the current operator or technician password (see Technician Menu sections 5.3.5 and 5.3.6).

Press OK to accept the password. The parameter name and current setting appear in the LCD display.

Press OK again. The LCD display shows the parameter and the current setting.

Enter the new parameter setting:

a) Press the up or down arrow until the desired value is reached.

b) The second row of the LCD display, below the value that is being changed, shows the current value.

Press Enter to save the new setting or Esc to abort without saving the new setting.

To change the settings of additional parameters, press Menu until the desired parameter appears in the LCD display. Repeat steps 6-8 above to set the new parameter.

Note

The Menu button displays the next parameter in the list, so that the operator can check every parameter in the menu. There is no scroll-back option. To view or change a previous parameter in the menu, you must exit the menu by pressing Esc, and start the above procedure from the beginning.

5.3.5 Technician Menu

The Technician Menu includes advanced parameter settings that are accessible separately from the Operator Menu. Anyone can view the settings, but only someone with the technician password can change them. This has been done to allow only those who are qualified to change the advanced controller settings. These are also settings that should not require frequent changes after the initial installation and set-up.

Table 4 - Technician Menu Functions and Descriptions

Function Name	Description
Cl P factor	Proportional Factor for Cl **Relay 1**
Cl pump period	1 Pump cycle (on+off time) for Cl relay
Cl pump freq.	Cl pump max pulses/min, 0 for on/off pump
Cl averaging	Displays an average of the last 4 Cl readings This feature will only affect the displayed value; not the action of the analyzer. This feature is intended primarily to prevent operators from making changes due to minor, normal fluctuations in the measured chlorine level. The averaging is done on the last 4 readings displayed on the screen and the result will be displayed in the next measurement. The analyzer will always act based on the last reading and not according to the averaging value
Cl < 0.1 alarm	Initiates an alarm and opens Cl relays 1 + 2, if Cl drops below this level. Whenever the Cl measurement is < 0.1 ppm, the analyzer will disable relay 1 and relay 2. This alarm is provided as an extra level of safety against over chlorination due to bleaching of reagents. However, it complicates the start-up of the analyzer when the Cl is being maintained at low levels. Therefore, this alarm feature may be turned off. For cases when the Cl level is always expected to be above 0.5ppm, Blue I Water Technologies highly recommends that this alarm remain in use except for start-up.
pH p factor	Proportional Factor for pH **Relay 3**
pH pump period	1 pump cycle (on + off time) for pH **relay 3**
pH pump freq.	pH pump max pulses/min, 0 for on/off pump
pH balance type	To select if Acid or Base is being added to adjust pH
Flow sensor	Turns Flow sensor on/off (optional module)
Flow rate	Choose between metric and US units
Celsius / Fahrenheit	Choose between metric and US units
Turbidity*	Turns Turbidity module on/off (optional module)
NTU wiper interval*	Cleaning glass interval for turbidity module (optional module)
Minutes	Current time for Data Logger
Hour	Current time for Data Logger
Day	Current time for Data Logger
Month	Current time for Data Logger
Year	Current time for Data Logger
Recording interval	Time interval between readings to be stored on the on-board data logger

Tot chlor*	Turns Total chlorine measurements on/off – will only operate in the Free Or Total (FOT) version
Chlor ratio*	The ratio of Free Chlorine measurements to Total Chlorine measurements
View free chlor	Displays measurement value on LCD
View pH*	Displays measurement value on LCD
View ORP*	Displays measurement value on LCD
View conductivity*	Displays measurement value on LCD
Address	Controller ID – used with external communications
Ver.	Current SW version
Max flow range	Maximum Flow Rate (flow at 20mA) of 4-20mA module
4-20mA Output Settings	Configures outputs for internal 4-20mA module
On alarm go to	4-20mA output during an alarm condition
Reagent pump time	Enables to tune the amount of reagents according to the water ingredients
Modbus com. format *	Modbus communications protocol options
Operator password	Change operator's password
Technical password	Change technician's password

* Optional features

Table 5 - Technician Menu and Variable Limits

Function Name	Min Value	Max Value	Default	Units
Cl P factor	0.1	50	0.1	--
Cl pump period	0.5	4	0:30	min
Cl pump freq.	0 (0=on/off pump)	120	0	max pulses/min
Cl averaging	OFF	ON	ON	--
Cl < 0.1 alarm	OFF	ON	ON	--
pH p factor	0.1	100	1.0	--
pH pump period	0.5	4	0:30	min
pH pump freq.	0 (0=on/off pump)	120	0	max pulses/min
pH balance type	Acid	Base	Acid	--
Flow Sensor	OFF	ON	OFF	--
Flow rate	M^3/hour	GPM	M^3/hour	--
Celsius / Fahrenheit	^0C	^0F	^0C	--
Turbidity*	OFF	ON	OFF	--
NTU wiper interval*	1	60	2	min
Minutes	1	59	n/a	min
Hour	0	23	n/a	hour
Day	1	31	n/a	day
Month	1	12	n/a	month
Year	1	99	n/a	year
Recording interval	1	240	0:03	min
Tot chlor*	OFF	ON	OFF	--
Chlor ratio*	1	30	1	--
View free chlor	OFF	ON	ON	--
View pH*	OFF	ON	ON	--
View ORP*	OFF	ON	ON	--
View conductivity*	OFF	ON	ON	--
Address	1	32	1	--
Ver.	n/a	n/a	n/a	--
Max flow range	9	200 / 999	200	M^3/hour or GPM

4-20mA Output Settings*				
Built-in ch. #	1	2	1	-
4-10/NTU ch. # *	1	4	1	-
Parameter	-	-	F-CL	-
“read or control” (Cl only)	-	-	Read	-
Set value for 4mA	4	20	4	mA
Set value for 20mA	4	20	20	mA
Set Test channel	2	20/hold	2	mA
On alarm go to	2	20	2	mA
Reagent pump time	0.8	2.5	1.1	sec
Modbus com. format *	0	31	0	--
Operator password	1	999	123	---
Technical password	1	999	456	---

* Optional features

5.3.6 Configuring Settings in the Technician Menu

Navigation within the Technician Menu is identical to the Operator Menu.

1) To enter the Technician Menu, press Menu to enter the Operator Menu and then press the up arrow and down arrow simultaneously until the menu display changes.
2) Locate the desired parameter in the menu:
   a) Press Menu until the desired parameter name appears in the LCD display.
   b) Press OK. “Enter Password 100” appears in the LCD display.
3) Enter the Technician Menu password:
   a) Press the up arrow or down arrow until the password number is reached.
   b) Press OK. The parameter name and current setting appear in the LCD display.

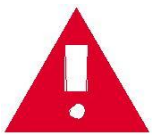
Note

Technician Menu password is different from the Operator Menu password. The default **Technician Menu password** is 456 and if lost, can **only be reset by replacing the control panel card.**

Continue adjusting parameter settings, as described in the Operator Menu (See sections 5.3.3 and 5.3.4 above).

5.4 Calibration

Parameters must be calibrated with measurements taken with external photometric testing devices. Always use digital calibration devices, not the less accurate visual test kits. Alternatively, standard solutions may be used. Make sure the standard solution is not expired or contaminated prior to using. Follow the procedures below EXACTLY as instructed.



ALWAYS take water for calibration from the valve of the pressurized sampling cell, NOT from the process line directly. The analyzer should always be calibrated with water from the same source.

Note

It is recommended that calibration be performed every 6 to 12 months. Minor deviations will exist between all testing equipment. These minor differences do not warrant the calibration of the colorimeter.

5.4.1 Chlorine Calibration

Note

Chlorine calibration should always be performed at **the 5th measurement cycle,** in order to enable stabilization of the conditions.

1) Open the water sampling valve. Let water flow while observing the colorimeter countdown timer in the LCD display.
2) Fill the sampling container when the countdown timer reaches zero (0).
3) Test the water sample for chlorine using a digital photometer.
4) Press Menu until "**Cl Calibrated to**" appears in the LCD display.

   The top line will display "Cl Calibrated to" and a number. The number displayed is the last value entered for the calibration.

   The bottom line will display "Sensor value was" and a number. This number is the sensor reading without any calibration at the time of the last calibration.

   A large discrepancy between these two numbers indicates that the sensor was calibrated improperly or the sensor needs to be replaced.

The value displayed normally on the main screen and the value the controller uses to determine dosing rates is the calibrated value.

Note

Chlorine calibration should always be performed within 25% of the set point. If the current chlorine level is 25% above or below the set point, do not perform calibration until the chlorine level is closer to the set point.

Press OK.

Enter the password. Press the up or down arrow until the password is reached.

Press OK.

Press OK again.

The display will now show "Calibrate Cl to" on the top line and "Sensor reading is" on the bottom line.

The "Sensor Reading" is the current reading of the sensor with no calibration.

The "Calibrate Cl to" value is the new value that you want to set.

Figure 13: Sensor Reading After Calibration

Press the up or down arrow until the value is the same as the value given by the digital photometer.

Note

The HYDROGUARD will not allow calibration above +/- 0.5 ppm from the uncalibrated sensor reading. If the value given by the digital photometer is more than +/- 0.5 ppm from the currently calibrated value, retest the water in the digital photometer. If the value is still more than 0.5 ppm above or below the calibrated value, try testing the water with another device. If there is still a deviation of more than 0.5 ppm between the new digital photometer and the currently calibrated value, there may be a problem with the HYDROGUARD colorimeter, which cannot be corrected by calibration alone.

Press OK to save the new calibration or Esc to abort without saving.

Press Esc to return to the main display.

5.4.2 pH Calibration

1. pH is calibrated using Buffer 7 solution and Buffer 4 or 10.
2. Shut off the water inlet and outlet from the sampling cell.
3. Remove the pH sensor and temperature probe from the sampling cell.
4. Wipe the sensor probe with a dry cloth and submerge it and the (PT-100) temperature probe into a cup with the Buffer 7 solution. Wait for the reading to stabilize.

Note: The reading will not stabilize if the temperature probe is not in the buffer solution also.

5. Press Menu until “pH 7 Calibration” appears in the LCD display.
6. Enter the password. Press the up or down arrow until the password is reached.
7. Press OK.
8. Press OK again.
9. Press the up or down arrow until the value is registered as 7 pH.
10. Press OK to save the new calibration or Esc to abort without saving.
11. Press Menu once until “pH 4, 10 Calibration” appears.
12. Repeat steps 4 to 10 above with Buffer 4 or 10 solution.
13. Press Esc to return to the main display.

Note: pH and redox (ORP) sensors tend to be slightly erratic in the first 24 hours of operation. If the above calibrations are performed immediately after these sensors are installed or replaced, repeat the calibration procedure in approximately 24 hours.

Note: The temperature probe provides grounding and stabilizes the pH and ORP readings.

5.4.3 ORP (Redox) Calibration

ORP is calibrated using an ORP Standard Solution. A standard closest to the normal operating value should be used for calibration.

1. Shut off the water inlet and outlet from the sampling cell.
2. Remove the ORP sensor and (PT-100) temperature probe from the sampling cell.
3. Wipe the sensor probe with a dry cloth and submerge it and the temperature probe into a cup with the ORP Standard Solution and wait for the reading to stabilize.

Note: The reading will not stabilize if the temperature probe is not in the buffer solution also.

4. Press Menu until "**ORP Calibrated to**" appears in the LCD display.
5. Press OK.
6. Enter the password. Press the up or down arrow until the password is reached.
7. Press OK.
8. Press OK again.
9. Press the up or down arrow until the value is the same as the value printed on the label of the standard solution.
10. Press OK to save the new calibration or Esc to abort without saving.
11. Press Esc to return to the main display.

5.4.4 Temperature Calibration

Take a sample of water from the sampling cell.

1. Insert a digital thermometer into the sample.
2. Wait for the thermometer reading to stabilize.
3. Press Menu until "**Temperature Calibrated to"** appears in the LCD display.
4. Press OK.
5. Enter the password. Press the up or down arrow until the password is reached.
6. Press OK.
7. The value that appears is the last calibrated value.
8. Press OK again.
9. Press the up or down arrow until the value is the same as the independent digital thermometer.

10. Press OK to save the new calibration or Esc to abort without saving.
11. Press Esc to return to the main display.

5.4.5 Turbidity Calibration

Note: If turbidity is lower than 1.0 NTU, use NTUl calibration. If higher than 1.0, use NTUh calibration, as follows:

Take a sample of water from the sampling cell and perform external test for calibration.

1. Press Menu until "**NTUl Calibrated to/NTUh Calibrated to**" appears in the LCD display.
2. Press OK.
3. Enter the password. Press the up or down arrow until the password is reached.
4. Press OK.
5. The value that appears is the last calibrated value.
6. Press OK again to the display "**Calibrate NTUl to/Calibrate NTUh to"**.
7. Press the up or down arrow until the value is the same as the external calibration reading.
8. Press OK to save the new calibration or Esc to abort without saving.
9. Press Esc to return to the main display.

Note: When the HYDROGUARD is initially installed, the pH and ORP readings will continue to stabilize for the first 24-48 hours. Calibration should be performed only after that period of stabilization.

5.5 Calibration and Initial Operation Checklist

Before leaving the site, perform the procedure in this section and record the requested values.

Calibrate the following HYDROGUARD parameters and enter the information into the table below. If pH and ORP are reading slightly low, do not calibrate as they will continue to increase for the first 24-48 hours.

Table 6 - Calibration Table

Date	Site	Technician's Name
Parameter	**Analyzer Reading**	**External Device or Standard Value**
Free Cl		
Total Cl		
pH		
Redox (ORP)		
Temperature		
Turbidity		
Conductivity		
Flow Rate		

6 Routine Operation and Maintenance

Once installed by a qualified technician, HYDROGUARD can begin monitoring and controlling water quality. HYDROGUARD is specifically designed for easy operation; however some periodic maintenance is still required. Basic guidelines are provided in Table 7; however the schedule may vary depending on the actual conditions and use.

Table 7 - Periodic Maintenance Schedule

Service Required	Frequency Required
Replacing Reagents	Every 4 to 8 weeks
Cleaning Pre-Filter	Recommended: Check every 4 weeks or when dirt is visible on the filter
Calibration (pH, ORP, Temp, Cl, Turbidity)	Recommended: Every 6 to 12 months
Replacing Injectors Module, Pump Head, Tubing and Rotating Flow Switch	Every 12 months. These can be purchased as a yearly replacement kit.

- **Basic Operation** involves setting the desired parameters and monitoring the system for alarms. When operating normally, HYDROGUARD demands very little operator involvement.
- **Calibration:** Sensor sensitivity and accuracy can degrade or drift over time. For this reason, HYDROGUARD settings must be periodically recalibrated and compared with measurements from other measuring devices, such as electronic photometers, pH sensors, turbidity meters, and thermometers, or compared to standard solutions like pH buffers or ORP standards. See section 5.4.
- **Reagent Replacement:** HYDROGUARD uses a very small amount (0.03 ml) of chlorine reagents each time water is sampled. The adaptive measurement interval will automatically vary the testing interval depending on water stability. This allows the two 600 ml bottles last approximately 4 to 8 weeks. A Low Reagents alarm is issued when

either one of the reagent bottles approaches depletion and should be replaced. If the reagents are not replaced before the reagents are depleted, the testing and chlorine dosing will stop and a No Reagents alarm will be displayed; therefore, it is important to replace reagents before this occurs. See section 6.2.

- **Filter Cleaning:** The HYDROGUARD unit has a filter installed in its water supply pipe, which collects particles and impurities. It should be cleaned or replaced periodically, depending on water quality. The clear filter cover is clear, allowing for a quick visual inspection to determine if cleaning is required. See section 6.3 below.
- **Shut-down and Winterizing:** If the analyzer will not be operating for an extended period of time or is being stored in areas where temperatures drop below freezing:

  A. All water must be removed from the analyzer to prevent components from breaking and the probes must be removed, stored in a warm area and immersed in water at all times. See Section 6.4 below. The probes will last for several years if properly treated but will not read properly if exposed to freezing temperatures or stored dry.

  B. Prime the reagent pumps to remove all reagents from the tubes. See section 5.2.8.

- **During disassembly:** Be sure to retain all hardware for use during reassembly. Upgrade and replacement kits may re-use some original components.
- **Start-up and Preventive Maintenance:** A preventative inspection and cleaning of components should be completed whenever the analyzer is restarted after a long downtime (> 2 weeks) or at least annually if the analyzer is operating constantly. Likewise, the analyzer has several mechanical components that will wear out over time. To prevent future problems, these components should be checked and/or replaced periodically. This is most easily accomplished at the time of initial restart.
- **Troubleshooting:** Occasionally problems will occur with the analyzer readings or chemical dosing. These problems are most often simple to correct. The troubleshooting section provides instructions to help correct problems easily.

6.1 Monitoring HYDROGUARD Alarms

HYDROGUARD issues alarms when it detects chemical levels that are above or below the allowed range. Every alarm is automatically displayed in the LCD status display and logged in the data logger. Most deviations in chemical levels, however, are automatically corrected. Thus, the internal alarms do not immediately activate an external alarm. A delay mechanism prevents false alarms from minor deviations that were automatically corrected. The external alarm is only activated after an internal alarm has been continuously active for a certain period of time, as defined by the operator.

The "**Alarm Delay**" command in the Operator Menu sets the number of seconds HYDROGUARD waits before closing **Relay 5**, the relay that operates the external alarm. Only one alarm is shown at a time based on importance and the order in which it should be fixed. For example, if the pH is high and the ORP is low, only the pH alarm will be indicated since lowering the pH will likely also correct the low ORP. All of the alarms are presented in **Error! Reference source not found.**.

Table 8 - Alarm Descriptions and Results

Alarm#	Alarm	Description	Result
A1	No flow	There is not enough water reaching the controller.	Stop all chemical dosing (all relays are open).
A2	Low flow	The water flow rate in the main circulation pipe is lower than the flow limit.	Stop all chemical dosing (all relays are open).

Alarm#	Alarm	Description	Result
A3	Check CLRMTR connect	Communication error between colorimeter and colorimeter board.	No chlorine dosing – optional ORP emergency mode
A4	No reagents	Reagents are empty.	No chlorine dosing – optional ORP emergency mode
A5	Stuck piston	The piston is not moving properly.	No chlorine dosing – optional ORP emergency mode
A6	Unclean cell	The glass in the colorimeter is dirty.	No chlorine dosing – optional ORP emergency mode
A7	Replace light	LED in colorimeter is not working.	No chlorine dosing – optional ORP emergency mode
A8	Low reagents	Reagents are below 20%.	Blue LED will flash – message only
A9	Chlorine < 0.1	Chlorine unusually low.	No chlorine dosing
A10	High ORP	ORP above upper limit.	No chlorine dosing
A11	Low chlorine	Cl below lower limit.	--
A12	High chlorine	Cl above upper limit.	--
A13	Low pH	pH below lower limit.	--
A14	High pH	pH above upper limit.	--
A15	Low ORP	ORP below lower limit.	--
A16	High NTU	Turbidity above upper limit.	--
A17	EXTERNAL OFF	External flow switch is off.	No chemical dosing
A18	Total Cl high	Total Cl above upper limit.	--
A19	Combine Cl high	Combined Cl above upper limit.	--
A20	Replace DPD3	DPD3 low	Total Cl testing stops
A21	Temp. low alarm	Temperature below lower limit.	--
A22	Temp. high alarm	Temperature above upper limit.	--
A23	Cl Overfeed time	Cl dosing on for longer than max time.	Cl dosing stops until reset
A24	pH Overfeed time	pH dosing for longer than max time.	pH dosing stops until reset
A25	Conductivity low	Conductivity below lower limit.	--
A26	Conductivity high	Conductivity above upper limit.	--
	No emergency	No problem to allow ORP emergency mode.	--
A0	ORP Emergency Mode	ORP Emergency Mode. Problem with Colorimeter reading. ORP is now controlling until problem is resolved (up to 3.5 days only).	Use with care. This method has disadvantages and will not reflect same results as normal operational mode.
* No dosing only affects the relay operation. Alarm relay will close and all other relays will open.			

6.2 Replacing Reagents

HYDROGUARD issues a LOW REAGENTS alarm when the float at the end of one of the reagent siphons detects that one or both of the reagents is approaching depletion. After this time, HYDROGUARD will count down (internally) until the reagents are expected to be completely depleted (and when that time is reached the Cl analysis will automatically be stopped). The blue LED lights in the sampling cell will flash continuously until the reagents are replaced or fully depleted. When depleted a NO REAGENTS alarm is issued and the chlorine

relays are opened, preventing any additional chlorine from being added to the system. Replace the reagents prior to receiving the NO REAGENTS alarm:

1. Open the HYDROGUARD analyzing unit door.

2. Press the lever above the siphon cover on the chlorine indicator bottle and pull the bottom of the bottle until it drops down from the siphon.

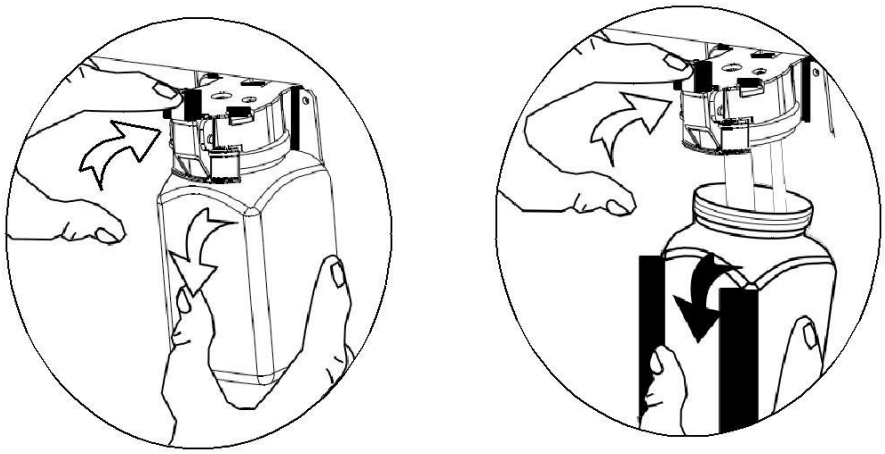


Figure 14: Press Tab above Siphon Cover and Pull Bottle Down

3. Wipe the siphons with a dry cloth.

4. Perform the procedure to mix and install new reagent bottles, as instructed in Section 5.2 Installing Reagents.

Caution: Do **NOT** pour remaining reagent fluid from the old bottle to new bottle. Mixing old and new reagent fluids destroys their effectiveness.

5. Repeat the steps above with the chlorine buffer bottle.

6. Prime the reagent pumps:
   Lift the colorimeter cap.
   a. Press Menu on the control panel keypad until the Reagent Pump menu appears
   b. Press OK
   c. Enter password (123 is default) using the up and down arrows
   d. Press OK (OFF will appear on top line)
   e. Press OK again (OFF will appear on the top and bottom lines)
   f. Press UP to turn the reagent pumps ON
   g. Press OK when the water flowing from the colorimeter has a red tint or when reagent drops are being formed at the needle tips
   h. Press Esc twice (2x) to return to the main screen
   i. Replace the reagent injector into its position

7. Close the analyzing unit door.

8. Locate the LCD detail readings window in the HYDROGUARD control panel.

9. Verify that the Low Reagent alarm message no longer appears in the bottom row.

   Locate the red LED **Cl** and **pH** readings indicators in the HYDROGUARD control panel.

   A number should appear in both displays.

.

Note
Once mixed (salt into the solution) the reagents have a shelf-life of 2 months, and will lose accuracy if used beyond this time limit.

6.3 Cleaning the Filter

HYDROGUARD comes with a pre-filter, which filters out sand, rust, course debris, oil, and other impurities in the sampled water. These impurities may clog HYDROGUARD's internal pipes, contaminate the sensors, or dirty the analyzing cell, reducing its accuracy.

This filter must be cleaned regularly as it becomes clogged with debris and impurities. The frequency at which the filter requires cleaning depends entirely on how much debris is in the water. The following procedure describes how to remove, inspect, clean, and if necessary, replace HYDROGUARD's filter cartridge:

1) Locate the water filter, mounted below the HYDROGUARD unit, and the valve that is located on the water supply pipe.

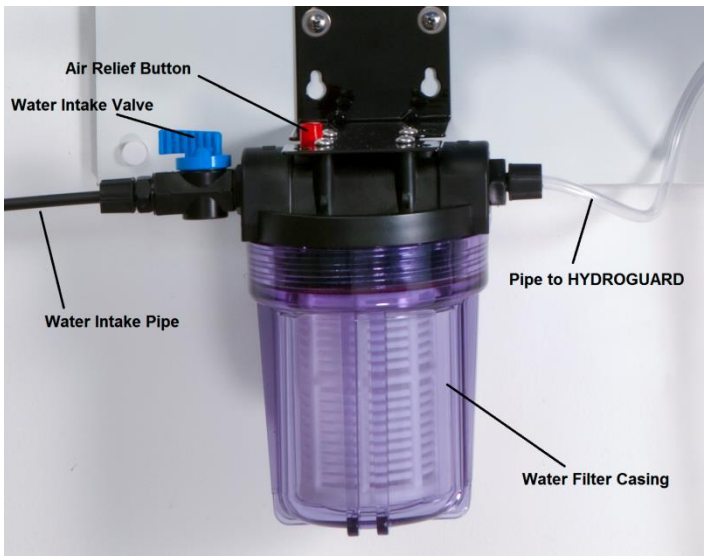


Figure 15: HYDROGUARD Unit's Water Filter

Turn off water supply to HYDROGUARD by shutting the water intake valve. Remove the filter.

A. Push the air relief button (1) for the filter top to reduce the vacuum and unscrew the filter casing (2).

B. Remove the cartridge from the filter casing (3).

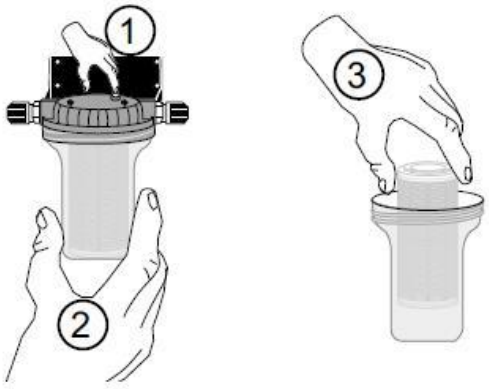


Figure 16: Pull Filter from Casing

4. Inspect the filter.
   A. Remove any loose debris with your fingers.
   B. Replace the filter if any part of the filter fabric is damaged.
5. Wash the filter with clean water.
   A. Point the high-pressure water jet towards the filter at a right angle and spray until all debris has been dislodged.
   B. Spray the water jet into the filter casing until all debris in the casing has been dislodged.

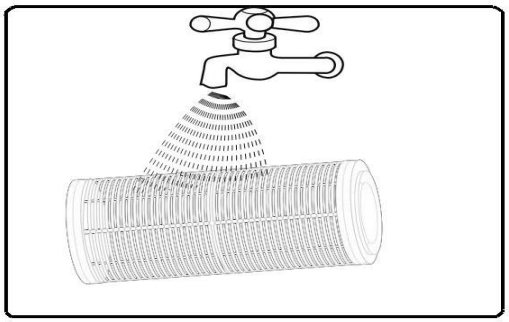


Figure 17: Wash Filter with Running Water

6. Return the filter into place.
   A. Place the cleaned or new filter into the casing and verify the gaskets at each end are compressed.
   B. Verify the casing's O-ring is in place and screw casing to filter base, until the gasket is firmly compressed against the filter connector pipe.
7. Open the water supply valve.

6.4 Shut-Down and Winterizing

The HYDROGUARD analyzer is designed to keep the probes submerged even if there is no flow to the analyzer. However, if the device is going to be offline for an extended period of time and/or exposed to freezing temperatures, it must be winterized to prevent damage to the analyzer and the probes.

1. Remove each probe from the sampling cell.

2. Fill the rubber caps (that were on the new probes) with tap water or preferably KCl (potassium chloride) solution and insert over the end of each probe.

3. Place the plastic cap over the top of each probe to protect the connector.

Note: If the original rubber caps are not available, fill a cup with water or solution and insert each of the probes.

4. Store in a safe location that will not drop below freezing, preferably in the original probe box for additional protection.
5. Drain the sampling cell completely by opening the sampling valve on the bottom. Leave the valve in the open position to allow air to completely dry the cell.
6. Remove the reagent bottles and flush each pump tube by inserting the pump tube in a container of fresh water and turning the reagent pumps ON until fresh water drips from the needles (following steps 8.a-g in Section 5.2 above).
7. Remove the pump tubes from the water containers and turn the pumps ON again until all water is removed.
8. Turn off the power to the analyzer.
9. Check that the analyzer doors are secure.

6.5 Start-up and Preventive Maintenance

After the analyzer (or flow) has been off for a long period of time (> 2 weeks), a few simple checks should be done during the initial start-up. Several components may need to be cleaned and some mechanical parts may need to be replaced as preventative maintenance.

1. Remove the colorimeter cap and clean the quartz glass using a cotton swab.
2. Remove the solenoid valve and check the tip for corrosion (this may occur if shut down improperly) and check the stop for signs of deterioration. Corrosion can usually be cleaned away and the solenoid valve will continue to work properly. After start-up, confirm that the water is completely stopped when the solenoid valve is closed. If it is not closing properly, it must be cleaned or replaced.
3. Inspect the pump tubes for cracks or signs of significant wear, and replace if necessary. (See Section 6.5.1 below.)
4. Install new reagents and prime the tubes until reagent drips from the colorimeter cap needles. (See Section 5.2.8)
5. If reagents are not dripping as they should, replace the colorimeter cap with a new one.

6. Reinsert probes in the sampling cell, close the sampling valve and turn on flow immediately to ensure that the electrodes are covered with water.
7. Recalibrate the analyzer: Cl, ORP, pH, Turbidity and Temp. (See section 5.4. above)

Note
ORP and pH probes will likely require 24-48 hours to re-stabilize and will require re-calibration at this time.

6.5.1 Replacing Pump Head and Tubes

If the pump head and/or tubes are cracked, appear significantly worn, or are no longer functioning properly, they should be replaced to ensure consistent operation and control.

1. Turn off the power to the HYDROGUARD analyzer.
2. Remove the tubes from the reagent pump head and pull the tubes out of the colorimeter cap.
3. Remove the tubes from the reagent bottles and wipe off any excess reagent (the DPD will stain so be careful).
4. Unscrew the two (2) screws on the front of the pump head. Save the screws.
5. Remove the pump head by pulling gently and sliding the pump head off the motor assembly
6. Slide the new pump head onto the motor assembly ensuring that the slot in the pump head matches the notch in the motor shaft. DO NOT force the pump head onto the motor assembly; it should easily slide into place.
7. Rotate the pump head and slide the alignment pins into the motor assembly.
8. Replace the two (2) screws to reattach the pump head.
9. Attach the new pump tubes by pressing the tubes onto the connectors on the end of the pump head.
10. Insert the pump tube leading to the bottom of the pump head into the appropriate reagent bottle.
11. Attach the pump tube from the top of the pump head to the colorimeter cap.

6.6 Troubleshooting

The following procedures instruct how to locate, evaluate, and fix a problem when HYDROGUARD issues an alarm or indicates suspect chemical levels. Table 9 outlines some controller problems that may generate an alarm, potential causes and solutions. Table 10 outlines some possible problems that may occur but will not generate an alarm, their potential causes and solutions.

Table 9 - Troubleshooting: Alarm Descriptions and Solutions

Alarm	#	Description	Symptom	Solution/Suggestion
No flow	A1	There is not enough water reaching the controller. Stop all chemical dosing.	No chlorine measurements. No dosing.	Increase flow and check flow switch wire connection on board. Check that the switch is not stuck.
Low flow	A2	The water flow rate in the main circulation pipe is lower than the flow limit. Stop all chemical dosing (all relays are open).	No dosing	Check the circulation pipes. It is not a controller problem.
Check CLRMTR connect	A3	Communication error between colorimeter and colorimeter board.	No Cl measurements	Check wiring between colorimeter sensor and colorimeter board. Change colorimeter sensor in case of continued problem.
No reagents	A4	Reagents are empty.	No reading	Check reagent level and change bottle if needed. Make sure the sensor is not stuck.
Stuck piston	A5	The piston is not moving properly within the colorimeter.	No chlorine measurements. No chlorine dosing.	Wait for the second measurement and check visually. Clean the colorimeter assembly. Make sure the colorimeter connection is well-connected to the “mixer” on the control panel. It is also possible that there is not enough flow to the colorimeter. Increase the flow to the analyzer.
Unclean cell	A6	Impurities have accumulated in the colorimeter analyzing cell.	No chlorine measurements. No chlorine dosing.	Clean the tube with a cotton swab. It is also possible that there is not enough flow to the colorimeter. Increase the flow to the analyzer.
Replace light	A7	LED in colorimeter is not working. Insufficient connection on the board.	No chlorine measurements. No chlorine dosing.	Re-solder LED connection. Change colorimeter assembly.
Low reagents	A8	Reagents are below 20%. Notifies how many days until the reagents are depleted.	Blue LED will flash – message only	Message only – NOT an error. Indicates reagents are needed soon.
Chlorine < 0.1	A9	Chlorine level is below 0.1 PPM.	No chlorine dosing	Compare to manual reading. If normal operation will be around 0.1 ppm range, then disable alarm.
High ORP	A10	ORP above upper limit.	No chlorine dosing as safety against over-chlorination.	Compare to manual reading and recalibrate if necessary. Check unstable reading due to poor grounding. Increase high/low ORP level if operation is normal. Replace probe if needed.

Alarm	#	Description	Symptom	Solution/Suggestion
Low chlorine	A11	Cl below lower limit.	Message Only	Compare to manual reading. Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check water flow. Verify piston movement (‘mixing”). Check that dosing systems are operating properly.
High chlorine	A12	Cl above upper limit.		
Low pH	A13	pH below lower limit.	--	Compare to manual reading and recalibrate if necessary. Check if unstable reading is due to poor grounding. Increase high/low pH level if operation is normal. Replace probe.
High pH	A14	pH above upper limit.	--	
Low ORP	A15	ORP below lower limit.	--	Compare to manual reading and recalibrate if necessary. Check if unstable reading is due to poor grounding. Increase high/low ORP level if operation is normal. Replace probe.
High NTU	A16	Turbidity above upper limit.	--	Check constant reading. Compare to manual reading. Check wiper movement. Clean sensor window. Change if necessary.
External Off alarm	A17	External flow switch is off. No chemical dosing (all relays are open).	--	Make connection on I/O board with flow sensor on connections 5 + 6 or with jumper wire to complete circuit. Not recommended to operate with jumper only.
Total Cl high	A18	Total Cl above upper limit.	--	Compare to manual reading. Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check water flow. Verify piston movement (‘mixing”). Check that dosing systems are operating properly.
Combine Cl high	A19	Combined Cl above upper limit.	--	--
Replace DPD3	A20	DPD3 low	No reagent in the right bottle out of the three.	Replace Total Chlorine reagent.
Temp. low alarm	A21	Temperature below lower limit.	--	--
Temp. high alarm	A22	Temperature above upper limit.	--	
Cl Overfeed time	A23	Cl dosing on for longer than max time and has shut off for safety reasons.	Cl dosing stops until reset	Confirm proper operation of dosing systems and perform a system reset.

Alarm	#	Description	Symptom	Solution/Suggestion
pH Overfeed time	A24	pH dosing for longer than max time and has shut off for safety reasons.	pH dosing stops until reset	Confirm proper operation of dosing systems and perform a system reset.
Conductivity low	A25	Conductivity below lower limit.	--	--
Conductivity high	A26	Conductivity above upper limit.	--	--
No emergency		No problem to allow ORP emergency mode.	--	--
ORP Emergency Mode	A0	ORP Emergency Mode. Problem with Colorimeter reading. ORP is now controlling until problem is resolved (up to 3.5 days only).	Use with care. This method has disadvantages and will not reflect same results as normal operational mode.	Function may be enabled, after no solution for alarms A3/4/5/6/7.
* No dosing only affects the relay operation. Alarm relay will close and all other relays will open.				

Table 10 - Troubleshooting: Problems and Suggested Solutions

Problem / Symptoms	Potential Cause	Solution / Suggestion
Chlorine Measurement is Zero or Low	Reagent Pumps not Primed or broken	Prime for 90 seconds - confirm pumps work properly and droplets form and drop from each needle
	Chlorine too high (> 10ppm) and is bleaching reagents	Dilute and test manually -- controller will operate fine once back in normal level
	Solenoid not shutting completely	confirm that water stops flowing when reading starts (timer gets to zero). Unscrew solenoid and clean the tip -- check filter for holes.
	Using wrong or not original reagents or reagents have passed expiration date	make sure reagent are in good conditions, replace if needed
	Needles Blocked/Damaged	Turn reagents pumps ON and confirm that droplets forming as expected
	Valve malfunctioning.	Check/Clean valve and spring. Add grease. Replace Valve if necessary.
	Needle is cracked or tube split at needle	Needle will be black on outside -- DPD occasional does not drop properly b/c not flowing through needle
Chlorine Measurement Inconsistent	Cl averaging on	Check if Cl averaging on in Tech menu -- turn off it not wanted
	Calibrated at wrong level	Enter calibration -- enter password and press enter to accept reading from colorimeter
	Valve malfunctioning.	Check/Clean valve and spring. Add grease. Replace Valve if necessary.
	Needs Calibration (near set point)	If +/- 25% of set point, re-calibrate

6.7 Replacing Components

The following procedures describe how to replace certain HYDROGUARD components.

Caution

The following procedures should only be performed by properly qualified and trained HYDROGUARD analyzer technicians.

Warning

Disconnect all power supplies to the HYDROGUARD analyzer before opening the control unit door. Replacing any HYDROGUARD parts without the expressed written authorization of Blue I Water Technologies Ltd. or the qualified representative who supplied the product may void the warranty.

Blue I Water Technologies Ltd. takes no responsibility, written or implied, for installation or maintenance of HYDROGUARD that is not performed by a properly trained and certified HYDROGUARD technician.

6.7.1 Replacing Sensors

Replacing the pH or ORP sensor (see also Section 5.1, Installing Additional Sensors):

1. Turn off the inlet and outlet water to the sampling cell and the power to the controller.
2. Open the doors of both the analyzing module and the control module.
3. Locate the sensor in the sampling cell that is to be replaced. The specific sensor may be identified by the label on the wire or by tracing the wire from the control panel back to the sensor.
4. Remove old sensor from the sampling cell:
    a. Unplug the sensor's wires from the sensor by grabbing the connector at the top end of the sensor and unscrewing the connector.
    b. Unscrew the sensor from the sampling cell.
    c. Pull the sensor up until its glass tube or metal probe clears the hole.
5. Prepare the new sensor to be installed:
    a. Open the replacement sensor's box and remove the sensor by the metal connector.
    b. If the sensor has a rubber or plastic plug at the tip of the glass tube, remove the plug and shake the sensor. The protecting oil inside the glass tube may interfere with the sensor's readings.
6. Install the new sensor:
    a. Hold the sensor by its metal connector, with the glass tube pointing down, and insert the glass tube into a hole in the sampling cell.
    b. Screw the probe into place. DO NOT OVERTIGHTEN.
    c. Screw the sensor wire onto the probe.

6.7.2 Replacing the Temperature Probe

1. Turn off the inlet and outlet water to the sampling cell and the power to the controller.
2. Open the doors of both the analyzing module and the control module.
3. Remove the four (4) wires from the temperature probe in the control module.
4. Remove old sensor from the reading cell:
    a. Unscrew the compression fitting from the temperature probe.
    b. Pull the probe up until it clears the fitting.
5. Install the new sensor:
    a. Insert the temperature probe into the fitting.
    b. Screw the compression fitting around the probe.

6.7.3 Replacing the Flow Switch

1. Turn off the inlet and outlet water to the sampling cell and the power to the analyzer.
2. Open the doors of both the analyzing module and the control module.
3. Locate the flow switch attached to the sampling cell.
4. Disconnect the flow switch wires from the I/O module.
5. Remove the inlet connection to the old flow switch.
6. Remove the flow switch from the sampling cell.
7. Pull the flow switch wires gently to completely remove them from the analyzer.
8. Insert the new flow switch on the sampling cell.
9. Insert the inlet connection on the flow switch.
10. Route the flow switch wires back to the connection on the I/O module and connect the wires to points 3 and 4 on the input switch terminal block.
11. Close the analyzer doors, turn on the water and power and ensure proper operation.

6.7.4 Replacing Reagent Siphons

1. Turn off the power to the analyzer.
2. Disconnect the two (2) red wires from the reagent level connector on the colorimeter card.
3. Remove the four (4) mounting screws.
4. Install the new reagent siphons:
    a. Attach the four (4) mounting screws.
    b. Connect the two (2) red wires to the colorimeter card.

6.7.5 Replacing the Reagent Level Switch

1. Turn off the power to the analyzer.
2. Disconnect the two (2) red wires from the reagent level connector on the colorimeter card.
3. Unscrew the old reagent level switch and pull out the switch along with its two (2) red wires.
4. Install the new switch by first pushing the two (2) red wires into the reagent bottle holder tube.
5. Screw in the switch by hand.
6. Reconnect the two (2) red wires to the colorimeter card.

6.7.6 Replacing Reagent Pumps

1. Turn off the power to the analyzer.
2. Disconnect both pipes from the reagent pump.
3. Remove the four (4) mounting screws.
4. Disconnect the red and blue wires from the reagent pumps connector on the colorimeter card.
5. Install the new pump and reconnect (in this order): the pipes, the 4 screws and the wires to the colorimeter card.
6. Lift the colorimeter cap and turn the reagent pumps on until the reagents begin to drip into the colorimeter from the needles (following steps 8.a-g in Section 5.2 above).

Note

If the reagent pump needs to be replaced, the pump head will have to be removed and reattached. See Section 6.5.1 **Replacing Pump Head and Tubes**.

6.7.7 Replacing the Colorimeter Assembly

The HYDROGUARD water quality analyzer has a self-contained analyzing cell to determine the chlorine and turbidity levels in the water.

Follow the procedure below to replace the colorimeter assembly.

Close the water inlet and outlet from the pressurized sample cell and turn off the analyzer power.

Open the doors of both the analyzing module and the control module.

Locate the colorimeter assembly unit in the analyzing module (Part number 12 in Figure 1).

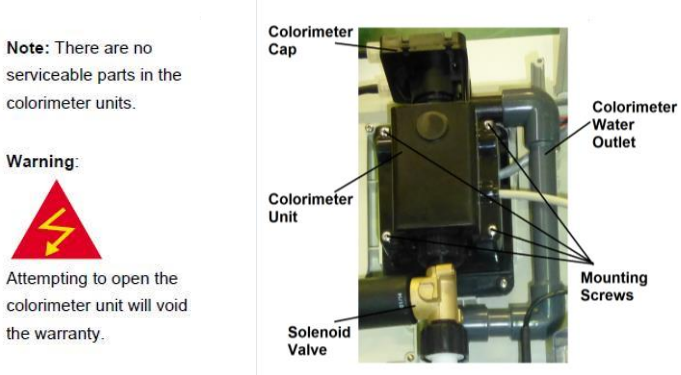

Note: There are no serviceable parts in the colorimeter units.
Warning:
Attempting to open the colorimeter unit will void the warranty.
Colorimeter Cap
Colorimeter Water Outlet
Colorimeter Unit
Mounting Screws
Solenoid Valve

Figure 18: Colorimeter Assembly Unit

Disconnect the existing colorimeter assembly:

a) Remove the top colorimeter cap from the colorimeter assembly. Make sure not to touch the reagent injection needles in the cap.

b) Disconnect the outlet tube from the colorimeter assembly.

c) Unscrew the union between the solenoid valve and the colorimeter assembly.

d) Unscrew the four (4) mounting screws that hold the colorimeter assembly to the HYDROGUARD housing.

e) Trace the wires from the colorimeter assembly to the colorimeter card. A total of 10 (10) wires are connected to the control module (4 connected to the “MIXER” terminal block and 6 to the “CM2 LED COLOR” terminal block).

f) Disconnect the colorimeter's wires from the colorimeter module.

Connect a new colorimeter assembly unit:

g) Hand-tighten the union between the colorimeter assembly and the solenoid valve until the colorimeter is tightly connected to the valve. Check that the O-ring is still in place.

h) Screw the colorimeter to the HYDROGUARD analyzing module housing with the four (4) mounting screws.

i) Place the top cap on the colorimeter assembly.

Re-connect the outlet tube to the colorimeter assembly.

Pass the wires from the new colorimeter through the gasket into the control module.

Connect the wires to the ”MIXER” and “CM2 LED COLOR” terminal blocks as indicated on the colorimeter module.

Verify that all wires are connected correctly.

Close the HYDROGUARD doors.

Turn on the power and restore flow to the pressurized sample cell.

Confirm that the colorimeter assembly is operating properly.

6.7.8 Replacing the Solenoid Valve

1. Close the water inlet and outlet to the pressurized sample cell and turn off the analyzer power.
2. Open the doors to the analyzing module and the control module.
3. With dry hands, unscrew and disconnect the red and black wires of the “Valve” connector on the colorimeter card.
4. Pull those wires through to the analyzing module and release all the way up to where they connect with the solenoid valve (but do not disconnect from the solenoid valve).
5. Loosen the top and bottom unions of the solenoid valves.
6. Unscrew the four (4) screws of the pressurized sample cell and swivel the cell to the left.
7. Fully release the top and bottom unions of the solenoid valve.
8. Replace the solenoid valve and remember to insert the O-rings when reconnecting with the top and bottom unions.
9. Complete the process by reattaching the pressurized sample cell in place with the four (4) screws, and reconnecting the solenoid valve cable to the colorimeter card.

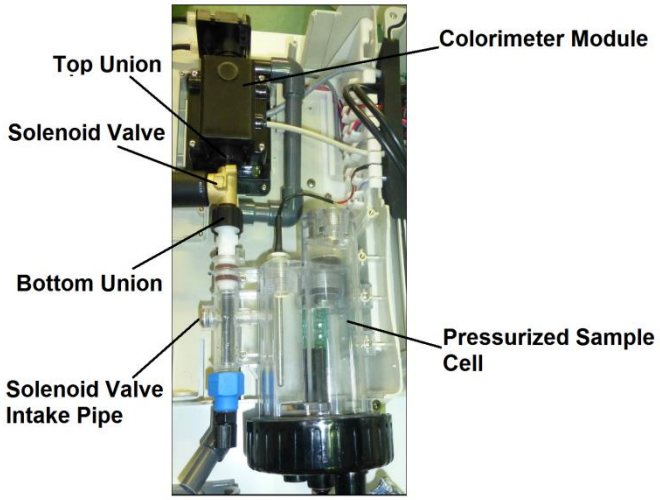


Figure 19: Solenoid Valve with Colorimeter Module and Sampling Cell

6.7.9 Replacing the Control Panel Module (Electronics Card)

Disconnect the power supply to the unit before opening the control unit.

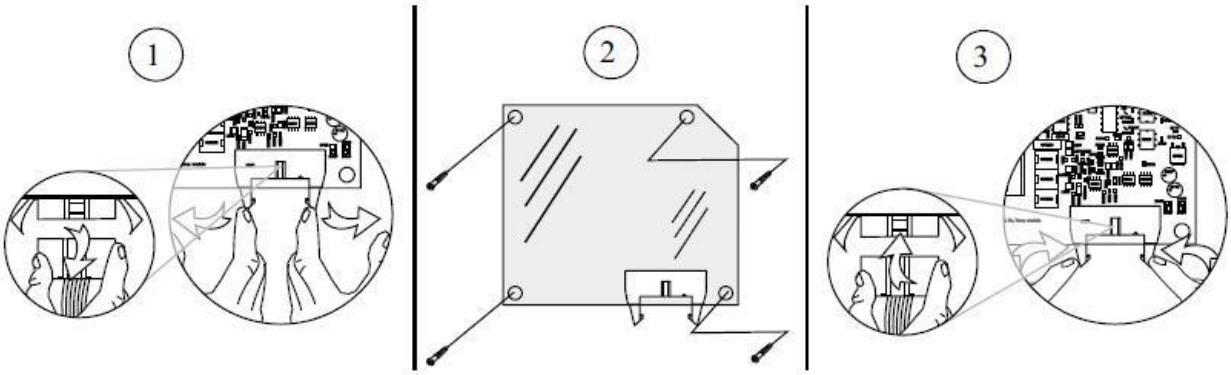


Figure 20: Replacing All Types of Electronic Card

1. Disconnect the flat cable plug from the card.
2. Unscrew the four (4) mounting screws.
3. Put in the new card and tighten the 4 mounting screws.
4. Connect the flat cable plug to the card.

6.7.10 Replacing the I/O Module

Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plugs from the card.
2. Unscrew the four (4) mounting screws.
3. Put in the new card and tighten the 4 mounting screws.
4. Connect the flat cable plug to the card.

6.7.11 Replacing the pH, Redox, and Temperature Card

Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card.
2. Unscrew the four (4) mounting screws.
3. Put in the new card and tighten the four (4) mounting screws.
4. Connect the flat cable plug to the card.

6.7.12 Replacing the Colorimeter Card

Disconnect the power supply to the unit before opening the control unit.

If pH, ORP, and/or temperature is being measured, first remove the pH, Redox and Temperature card.

1. Disconnect the flat cable plug from the colorimeter card.
2. Unscrew the four (4) mounting screws.
3. Put in the new colorimeter card and tighten the 4 mounting screws.
4. Connect the flat cable plug to the colorimeter card.
5. If removed, replace and reconnect the pH, Redox and Temperature sensors card as described in section 6.7.11.

7 Optional Features

7.1 Optional Measurements

The following additional measurements may be added to the HG-702:

- Free and total chlorine monitoring (instead of just free or total)
- Conductivity
- Flow Rate
- pH
- Redox (ORP)
- Temperature

7.2 Free and Total Chlorine Measurements

The Free and Total Chlorine Controller measures both free chlorine (F-Cl) and total chlorine (T-Cl). The free chlorine is the active chlorine in the water. When chlorine is added to water, hypochlorous acid (HOCl) is formed, which is the active agent that actually disinfects the water.

7.2.1 Installation

Warning: Before installing any new hardware, turn off all power supplies to the HYDROGUARD.

The Free Cl + Total Cl measurements are an optional feature that is supplied from the factory. However, in addition to the standard free chlorine set-up, some additional steps are required.

Required Parts:

The following components are required for total chlorine analysis and control:

- Red reagent bottle holder (1)
- Peristaltic Pump (1)
- Colorimeter Cap with 3 needles (1)
- Chip for control panel card with software version *FAT (Free And Total)*
- DPD3 reagent

A diagram of a Free and Total Chlorine analyzer is presented in Figure 21.

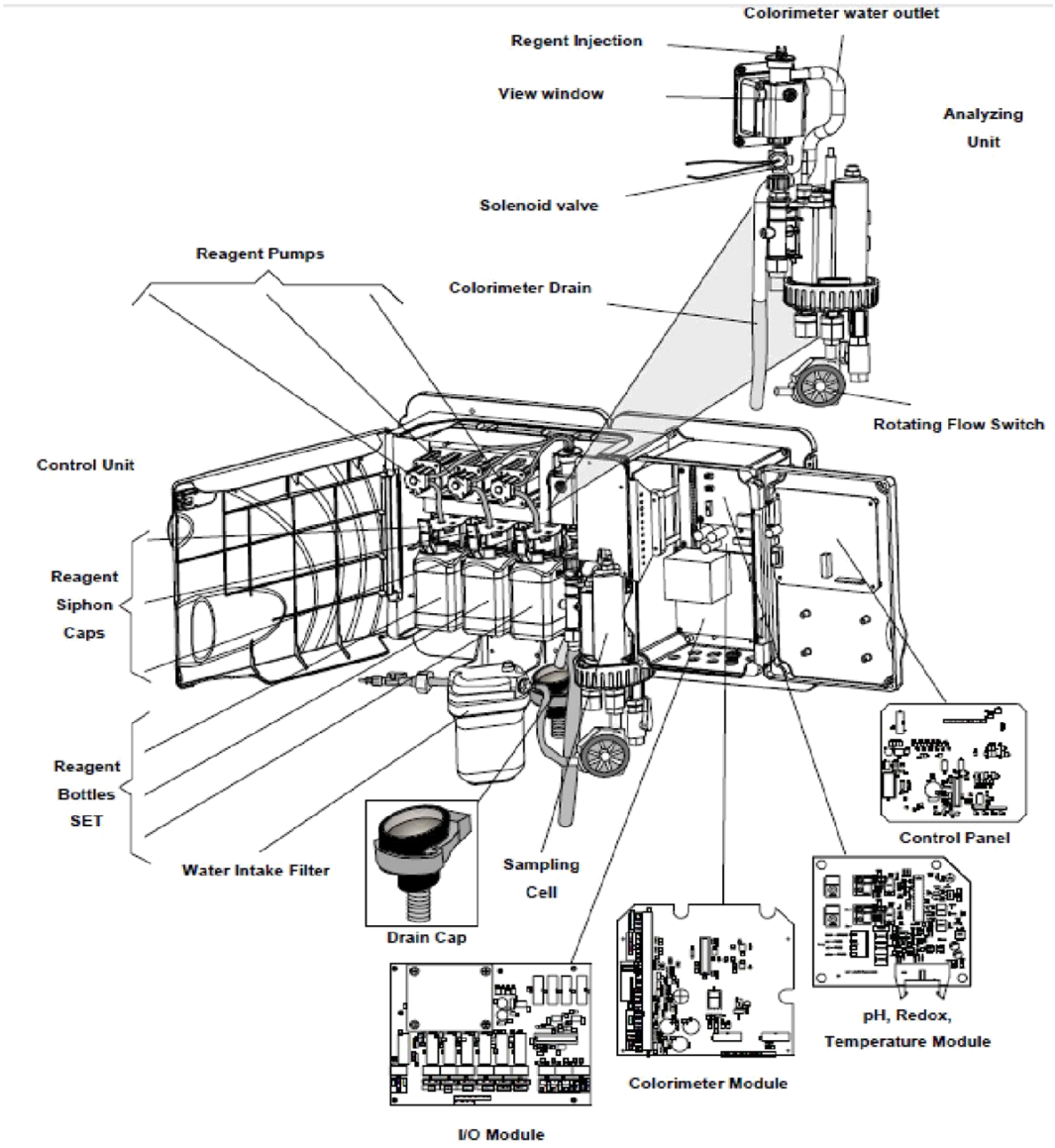


Figure 21: Free and Total Chlorine Controller

7.2.1.1 Installing New Colorimeter Cap

1. Remove the existing colorimeter cap by lifting up.
2. Remove the tubes from the existing colorimeter cap.
3. Insert tubes into the new colorimeter cap. For a Free and Total Chlorine Analyzer, connect the third needle to the new cap as well.
4. Press the new cap into place.

7.2.1.2 Installing a New or Additional Peristaltic Pump

1. Disconnect inlet and outlet tubes connected to the peristaltic pump.
2. Remove existing peristaltic pump by removing four (4) screws that hold the pump in place.
3. Open the electronics box and disconnect the two (2) wires – red and blue – where labeled “Reagent Pump (DPD)” according to the pumps being replaced.
4. Pull out the existing peristaltic pump from its place with the wires leading behind it, until fully release from the device.
5. Attach the new pump with four (4) screws in place and reattach the tubes.
6. Remove the screws holding the conduit cover in place.
7. Push the wires into the conduit and feed through to the opening on the right.
8. Push the wires through an available opening in the rubber gasket (make sure to push through closest to the final connection).
9. Connect the wires to the colorimeter card where labeled “Reagent Pumps (DPD).
10. For total chlorine (DPD3 peristaltic pump), connect the red and blue wires at the top two terminal connections (the connections are marked red and blue).
11. Replace the conduit cover and secure into place with the screws.

7.2.1.3 Installing the Pump Tubing

1. Remove the screws holding the transparent pump housing cover in place.
2. Remove the white rotor cover and release the tube.
3. Feed the new tube around the metal pump pins.

4. Replace the white rotor cover and then screw the pump housing cover back in place.

7.2.1.4 Installing Reagent Bottle Holder and Float Switch

1. Depending on the Reagent Bottle Holder being replaced, disconnect two (2) red wires from the colorimeter card where labeled “Reagent Level”.
2. Release the four (4) screws holding existing bottle holder in place.
3. Attach the new bottle holder with the screws.
4. Remove the screws holding the conduit cover in place.
5. Push the wires into the conduit and feed through to the opening on the right.
6. Push the wires through an available opening in the rubber gasket (make sure to push through closest to the final connection).
7. Connect the wires to the colorimeter card where labeled “Reagent Level”, according to the bottle holder being replaced.
8. Replace the conduit cover and secure into place with the screws.

7.2.2 Additional Menus and Settings

Total chlorine monitoring requires a few additional menus, alarms and settings to be configured before operating the analyzer.

The tables below indicate the additional items in the Operator and Technician Menus specific to Total Chlorine monitoring.

Table 11 - Additional features in Operator Menu (With Total Chlorine Monitoring)

Name	Description
Tot Chlor	Turns the total chlorine monitoring and display ON or OFF
Chlor Ratio	The ratio of Free Chlorine measurments to Total Chlorine Measurements

Table 12 - Additional Alarms (With Total Chlorine Monitoring)

Name	Description
TC High Alarm	Alarm when the Total Chlorine is above this value
CC High Alarm	Alarm when the Combined Chlorine is above this value

7.2.2.1 Alarms

The table below lists and describes the HYDROGUARD alarms, and the relays they activate.

Table 13 - Alarms (With Total Chlorine Monitoring)

Alarm #	Alarm	Description
A1	No flow	Flow switch on flow cell is off
A2	Low flow	External flow meter below minimum flow
A3	Check CLRMTR connect.	Communication error between Colorimeter and Colorimeter card
A4	No reagents	Reagents are empty
A5	Stuck piston	Piston is not moving properly
A6	Unclean cell	Glass in Colorimeter is dirty
A7	Replace light	LED in Colorimeter is not working
A8	Low reagents	Reagents are below 20%
A9	Chlorine < 0.1	Chlorine unusually low
A10	High ORP	ORP above high limit
A11	Low chlorine	Cl below low limit
A12	High chlorine	Cl above high limit
A13	Low pH	pH below low limit
A14	High pH	pH above high limit
A15	Low ORP	ORP below low limit
A16	High NTU	Turbidity above high limit
A17	EXTERNAL OFF	External flow switch is off
A18	Total Cl high	Total Cl above high limit

Alarm #	Alarm	Description
A19	Combine Cl high	Combined Cl above high limit
A20	Replace DPD3	DPD3 low
A21	Temp. low alarm	Temperature below low limit
A22	Temp. high alarm	Temperature above high limit
A23	Cl overfeed time	Cl dosing on for longer than max time
A24	pH overfeed time	pH dosing on for longer than max time
--	No Emergency	No problem to allow ORP emergency mode

7.2.2.2 Technician Menu

The following table lists the functions in HYDROGUARD's **Technician** Menu:

Table 14 - Technician Menu (With Total Chlorine Monitoring)

Menu #	Name	Description
51	Cl P factor	Proportional Factor for Cl Relay 1
52	Cl pump period	1 Pump cycle (on +off time) for Cl Relay 1
53	Cl pump freq	Cl pump max pulses/min, 0 for on/off pump
54	Cl Overfeed Time	Will open relay 1+2 if Cl feeding continuously for this time
55	Cl Averaging	Displays an average of the last 4 Cl readings
56	Cl < 0.1 alarm	If Cl drops below this level, Alarm indicated and Opens Cl Relay 1+2
57	pH p factor	Proportional Factor for pH Relay 3
58	pH pump period	1 Pump cycle (on +off time) for pH Relay 3
59	pH pump freq	pH pump max pulses/min, 0 for on/off pump
60	pH Overfeed Time	Will open relay 3 if pH feeding continuously for this time
61	pH balance type	To Select if Acid or Base is being added to adjust pH
62	Flow Sensor	Will turn display of Flow rate on/off (only use if flow meter connected)
63	Flow Rate	Choose between metric and US units

Menu #	Name	Description
64	Celsius/Fahrenheit	Choose between metric and US units
65	Temp hysteresis	Value in degrees, below set-point which will close Temp Relay 6
66	Turbidity	Turns Turbidity Module ON/OFF (optional module)
67	Minutes	Current Time for Data Logger
68	Hour	Current Time for Data Logger
69	Day	Current Time for Data Logger
70	Month	Current Time for Data Logger
71	Year	Current Time for Data Logger
72	Recording Interval	Time interval between readings stored on the on-board data logger
73	Tot Chlor ON/OFF	Turns the total Cl testing ON or OFF
74	Chlor Ratio	Ratio of Free Cl tests to Total Cl tests
75	Total/Combine chlor	Displays total chlorine or combined chlorine value
76	Address	Controller ID - used with external communication
77	S/W version	Current software version and ID number
78	4-20 mA Output Settings	Configures outputs for internal 4-20mA module
79	On Alarm go to	4-20mA output during an alarm condition
80	Operator Password	Change operator password
81	Technician Password	Change technician password

7.2.3 Total Chlorine Monitoring Setup

The following steps should be followed to change the analyzer from free chlorine measurement to total chlorine measurement.

1. Press Menu button
2. Press the up and down arrows together
3. Press Menu button repeatedly until “Tot chlor off” appears on the screen
4. Press OK
5. Insert password (default 456) and press OK
6. Press up or down button to change function to “On”

7. Press OK
8. Press menu button repeatedly until “Free Chlorine” appears on the screen
9. Press OK
10. Press up or down button to change function to “Off”
11. Press OK
12. Press Esc to exit menu

7.3 pH, ORP and Temperature Measurements

7.3.1 Installation

Refer to section 5.1.1 above for instructions on installation of pH, ORP (redox) and temperature sensors.

7.3.2 pH Calibration

Refer to section 5.4.2 above for instructions on pH sensor calibration.

7.3.3 ORP Calibration

Refer to section 5.4.3 above for instructions on ORP sensor calibration.

7.3.4 Temperature Calibration

Refer to section 5.4.4 above for instructions on temperature sensor calibration.

7.4 Conductivity Measurement

7.4.1 Installation

If the HYDROGUARD system was ordered with the Conductivity Sensor pre-installed some of these steps will have been completed in the factory.

Supplied Components

- Conductivity 4-20 input card
- 150mm flat cable (ribbon cable)
- Conductivity sensor
- Conductivity sampling cell

Caution

Prior to opening the analyzer or installing any electrical components, turn off all power supply to the analyzer.

1) Attach the conductivity card to the inside of the control panel door below the control panel module using the four (4) supplied screws.

Attach the ribbon cable from the conductivity card to any open connector on the I/O card.

Mount the conductivity sampling cell and sensor on a solid wall or surface using appropriate hardware (not supplied). Make sure that the distance is less than 15 meters (49 feet) from the HYDROGUARD analyzer.

Connect a water supply of no greater than 2 bar (30 psi) to the inlet fitting using 6mm tubing. It may be a new separate water supply or a line tapped from the main analyzer water supply before the pre-filter. Larger tubing may be used if the fitting is replaced to accept the new tubing.

Connect a 6mm water outline line to the outlet fitting and connect to:

a. The water system at least 0.3 bar (5 psi) lower than the inlet water supply, or

b. The pre-filter of the HYDROGUARD analyzer.

Route the conductivity sensor wire through an open gland on the bottom of the analyzer.

Connect the wires to an open 4-20mA input on the bottom of the 4-20 card.

Connect 24V from the meter to 24V on the card.

Connect mS from the meter to IN on the card.

Connect GND from the meter to ground (symbol) on the card.

7.4.2 First Time Set-up and General Operation

For output of the conductivity measurement, see internal or external 4-20mA card sections to configure the output in your specific HYDROGUARD analyzer.

7.4.3 Routine Maintenance

7.4.3.1 Conductivity Calibration

Conductivity calibration must be performed when the process is stable; specifically, the temperature should be within normal operating range.

1. Test a sample of water with an accurate external conductivity sensor.
2. Use the calibration adjustment screw to increase or decrease the conductivity, making very small changes.

Wait for the adjustment to take effect before making additional changes.

7.4.3.2 Cleaning the Conductivity Sensor

Routine cleaning of the conductivity sensor will ensure long-term reliability. The frequency of cleaning will depend on the water source being tested and should be conducted whenever there is significant visible dirt, the measurement accuracy is affected, or before the sensor is calibrated.

1. Shut off the flow of water to the conductivity sampling cell and remove the sensor.
2. Wash the sensor under a jet of water to remove the debris.
3. Use a soft cloth to remove any additional debris and oil.
4. Replace the sensor and restore flow to the sampling cell.

7.4.3.3 Replacing the Conductivity Sensor

1. Turn off the inlet and outlet water to the sampling cell and the power to the analyzer.

2. Open the door of the control card.
3. Remove the wires from the bottom of the conductivity input card.
4. Remove the sensor from the sampling cell by unscrewing the cap and pulling gently.
5. Install the new sensor in the sampling cell.
6. Route the wires back to the conductivity card and reconnect the wires to the 4-20 input card.
7. Restart the flow and turn the power on.
8. Confirm that proper operation has been restored.

7.4.3.4 Replacing the Conductivity Input Card

Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card.
2. Disconnect all terminal blocks.
3. Unscrew the four (4) mounting screws.
4. Put in the new card and tighten the 4 mounting screws.
5. Connect the flat cable plug to the card.
6. Reconnect the terminal blocks.

7.4.4 Shut-down and Winterizing

See also Section 6.4 above.

Shut off the flow of water to the conductivity sampling cell.

Drain the water from the sampling cell.

If the analyzer will not be operating for an extended period of time or is being stored in areas where temperatures drop below freezing, remove the conductivity sensor and store in a safe location where temperatures will not drop below freezing.

7.5 Flow Meter

Blue I Water Technologies does not supply flow meters. However, the analyzer supports a flow meter connection with input connections and display.

7.5.1 Installation

7.5.1.1 Required Components

- Flow meter (not supplied)– frequency or 4-20
- 4-20 input module if using 4-20 flow meter
- 150 mm flat cable if using 4-20 input module

Prior to opening the analyzer or installing any electrical components, turn off all power supplies to the analyzer.

7.5.1.2 Frequency Output Flow Meter

A flow meter with either two (2) or three (3) wires for a frequency output can be connected to the input switch section on the I/O module.

Installation

1. Install the flow meter following the manufacturer directions. Be sure to install close enough to HYDROGUARD that the wires will reach.
2. Pass the flow sensor cable through an open gland on the bottom of the analyzer.
3. Connect the two or three wires from the sensor cable to the input switch terminal block on the lower right corner of the I/O Module.
4. Although the flow meter is connected, it will not operate until it is set-up in the analyzer menu.
5. Press Menu until “Flow Low Limit” appears. Enter the low flow value (the flow value which will cause an alarm and will disable any direct chemical dosing).
6. Change to “Flow Sensor On”
7. Press Menu again and “K-factor” appears. Enter the k-factor for the flow meter being used (should be on paperwork with flow meter).
8. Press the up and down arrows simultaneously and then press Menu until “Flow Rate m3/hr” appears. Select the flow units of m3/hr or GPM.

7.5.1.3 4-20 Output Flow Meter

Any flow meter with a 4-20mA output can be connected to the analyzer’s internal 4-20 input card.

Install the flow meter as per the manufacturer’s directions.

1. Pass the flow sensor cable through an open gland on the bottom of the analyzer.
2. Connect the 4-20mA output wires from the flow meter to the middle 4-20mA Input connection on the input module.
3. Although the flow meter is connected, it will not operate until it is set-up in the analyzer menu.
4. Press Menu until “Flow Low Limit” appears. Enter the low flow value (the flow value which will cause an alarm and will disable any direct chemical dosing).
5. Press the up and down arrows simultaneously and then press Menu until “Flow Rate m3/hour m3/hr” appears. Select the flow units of m3/hr or GPM.
6. Press Menu until “Max flow Range” appears. Enter the maximum flow rate (flow rate at 20mA output). The minimum flow rate (flow rate at 4mA output) is assumed to be zero.
7. The flow meter should now be active. Confirm that the flow rate appears on the LCD display. If it is not active, perform a system reset.

7.5.2 Routine Flow Meter Maintenance and Troubleshooting

Follow manufacture’s recommendations for maintenance procedures and any troubleshooting issues for a flow meter.

7.6 Modbus Communication Protocol

Modbus is a serial communications protocol that allows for communication between many devices connected to the same network.

Note

If the HYDROGUARD analyzer is configured for **Modbus over Ethernet communication**, please refer to the setup instructions for this configuration and how to find the HG's IP at http://www.blueitechnologies.com/products/hydroguard-hg-702-turbiplus/ (see menus on this web page).

Modbus is configured via the Technician Menu.

1) To access the Technician Menu, press Menu to enter the Operator Menu and then press the up and down arrows simultaneously until "#51" appears on the LCD display changes.
2) First locate "Modbus com format" in the menu:
   a) Press Menu until "Modbus com format" appears in the LCD display.
   b) Press OK. "Enter Password 100" appears on the LCD display.
3) Enter the Technician Menu password:
   a) Press the up or down arrows until the correct password number is reached (default password is 456).
   b) Press OK. "Modbus com format" and its current setting appear in the LCD display.

Note

Technician Menu password is different from the Operator Menu password. The default **Technician Menu password** is 456 and if lost, can **only be reset by replacing the control panel card**.

Press OK, again. The LCD display shows the parameter and the current setting.

Enter the new parameter setting:

   c) Press the up arrow or down arrow until the desired parameter value is reached, according to the options listed in Table 15.
   d) The second row of the menu display, below the value that is being changed, shows the current value.

Press Enter to save the new setting or Esc to abort without saving the new setting.

Table 15 - Modbus Configuration Options

Parameter's value	Bit 4 2 stop / 1 stop bit	Bit 3 Floating point / Swapped floating point	Bit 2 19200bps / 9600bps	Bit 1 Parity Even / Odd	Bit 0 Parity / No parity
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	0
10	0	1	0	0	1
11	0	1	0	1	0
12	0	1	0	1	1
Parameter's value	**Bit 4 2 stop / 1 stop bit**	**Bit 3 Floating point / Swapped floating point**	**Bit 2 19200bps / 9600bps**	**Bit 1 Parity Even / Odd**	**Bit 0 Parity / No parity**
13	0	1	1	0	0
14	0	1	1	0	1
15	0	1	1	1	0
16	0	1	1	1	1
17	1	0	0	0	0
18	1	0	0	0	1
19	1	0	0	1	0
20	1	0	0	1	1
21	1	0	1	0	0
22	1	0	1	0	1
23	1	0	1	1	0
24	1	0	1	1	1
25	1	1	0	0	0
26	1	1	0	0	1
27	1	1	0	1	0
28	1	1	0	1	1
29	1	1	1	0	0
30	1	1	1	1	0
31	1	1	1	1	1

Table 16 - Modbus Communications Options

Parameter Name	Type	Address	Notes
Chlor main pump	Coil	0	
Chlor Addition. Pump	Coil	1	
Acid/ Base Pump	Coil	2	
Turbidity cleaner	Coil	3	
Temperature control	Coil	4	
Alarm Lamp	Coil	5	
Parameter Name	**Type**	**Address**	**Notes**
Low Reagent	Discrete Input	10015	
Alkali/Acid	Discrete Input	10016	
Flow sensor connection	Discrete Input	10017	
Turbidity module connection	Discrete Input	10018	
Chlorine averaging enable	Discrete Input	10019	
Chlorine <0.1 alarm enable	Discrete Input	10020	
Celsius/Fahrenheit	Discrete Input	10021	
Total Chlorine On/Off	Discrete Input	10022	
M3/H / GPM	Discrete Input	10023	
Free chlorine On/Off	Discrete Input	10024	
ORP On/Off	Discrete Input	10025	
pH On/Off	Discrete Input	10026	
Conductivity 4-20(1) On/Off	Discrete Input	10027	
No Flow	Discrete Input	10032	
Low Flow	Discrete Input	10033	
No Reagents	Discrete Input	10034	

Parameter Name	Type	Address	Notes
Chlorine<0.1	Discrete Input	10035	
ORP>XXX	Discrete Input	10036	
Unclean cell	Discrete Input	10037	
Replace light	Discrete Input	10038	
Low chlor.	Discrete Input	10039	
High chlor.	Discrete Input	10040	
Low Ph	Discrete Input	10041	
High Ph	Discrete Input	10042	
Low ORP	Discrete Input	10043	
High NTU	Discrete Input	10044	
External OFF	Discrete Input	10046	
Colorimetr comm. Error	Discrete Input	10047	
High total chlor	Discrete Input	10048	
High combine chlorine	Discrete Input	10049	
No DPD3	Discrete Input	10050	
Chlor overfeed time	Discrete Input	10051	
Ph overfeed time	Discrete Input	10052	
Piston stuck	Discrete Input	10053	
Low temperature	Discrete Input	10054	
High temperature	Discrete Input	10055	
Low conductivity alarm	Discrete Input	10056	
High conductivity alarm	Discrete Input	10057	
Free chlorine	Input Register	30000	Floating point IEEE-754
Parameter Name	**Type**	**Address**	**Notes**
pH	Input Register	30002	Floating point IEEE-754
Redox	Input Register	30004	Floating point IEEE-754
Temperature	Input Register	30006	Floating point IEEE-754
Flow	Input Register	30008	Floating point IEEE-754
Turbidity	Input Register	30010	Floating point IEEE-754
Total chlorine	Input Register	30012	Floating point IEEE-754
Combine chlorine	Input Register	30014	Floating point IEEE-754
Conductivity	Input Register	30016	Floating point IEEE-754
Colorimeter alarms	Input Register	30018	bit0 - Low Reagent bit1- No Reagents bit2 - No DPD3 bit3 - No Flo bit4 - External OFF bit5 - Unclean cell bit6 - Replace light bit7 - Colorimeter communication Error bit8 - Piston stuck
Controller ID	Input Register	30019	16 bit serial number

Modbus connection details	Holding Register	40000	bit0 - parity / noparity bit1 - parity even / odd bit2 - 19200bps / 9600bps bit3 - floating point / swapped floating point bit4 - 2 stop/1 stop bit
Chlor measures interval, sec	Holding Register	40001	

7.7 Communication Options

Modbus communications mapping is detailed in Table 16 above.

7.7.1 Internal 4-20 mA Output

7.7.1.1 Installation

Required Parts

- Internal 4-20 mA module (electronics card - included)
- 150 mm flat cable (ribbon cable - included)
- To complete the installation a 2-wire cable for each output channel/parameter will also be required (not included).

Hardware Installation

1) Attach the 4-20 mA module to the inside of the control panel door below the control panel card using the 4 supplied screws.
2) Attach the ribbon cable from the 4-20 mA module to any open connector on the I/O module.

Electrical Installation

The 4-20 mA module is powered through the ribbon cable and does not require a separate electrical supply.

Configuration

For Free Cl only, the 4-20mA output may be set to Read or Control.

- Read Mode will operate like the standard 4-20 mA output and send an output related to the measured value. See section 7.7.1: Internal 4-20 mA Output.
- Control Mode will send an output to control the feed system based on:
    - Measured value
    - F-Cl set-point 1
    - Cl P-factor

  The Control Mode has 2 options: normal and inverted (“Invert” in the menu)

  - Normal:
      - 4 mA = No Cl dosing
      - 20 mA = Max Cl dosing
  - Inverted:
      - 20 mA = No Cl dosing
      - 4 mA = Max Cl dosing

The menu for “4-20 mA output settings” is found in the Technician Menu.

1) Set the 4-20 mA outputs
   a) Enter the Technician Menu and scroll until “4-20mA output settings” appears in the LCD.
   b) Press OK.
   c) Enter the technician password and press OK.

Note
The default **Technician Menu password** is 456 and if lost, can **only be reset by replacing the control panel card**.

   d) Select Channel.
      i) Select “Built-in ch. # “(1 - 2) and press OK.
      ii) Select “4-10/NTU ch. # “(1 - 4) and press OK.
   e) Select Parameter (F-CL, pH, ORP, Temp, Flow, NTU, T-CL, C-CL, Cond) and press OK.

Note
Optional features appear in the selection as well.

   f) Select “read” or “control” function (for F-CL only)
      --If control was selected, set control to “Normal” or “invert” and press OK.
   g) Select “Set value for 4mA” and press OK.
   h) Select “Set value for 20mA” and press OK.
   i) Select “Set Test channel” (to be used for troubleshooting purposes or initial tests): 2mA, 4mA, 12mA, 20mA and press OK.
   j) Press Esc to return to the set-up menu and repeat the above steps for all active 4-20mA.

Set the 4-20mA alarm output (output value in case of measurement or communication error).

This is the 4-20mA output value that will indicate whenever an alarm condition exists or communication between the analyzer and 4-20 module is interrupted.

k) “on alarm go to” option follows the “4-20mA output settings” in the Technician Menu.
l) Select “on alarm output”: 2mA, 4mA, 20mA, or hold.

Note
The 4-20mA alarm output is the output value that will be transmitted in case of insufficient flow to the HYDROGUARD. In case of low or high level (i.e., low chlorine), no 4-20 mA alarm will be activated.

Confirming Operation and Communication

Prior to connecting to the external monitoring or control system, it is best to confirm that all desired outputs are working properly using a digital multimeter. This must be done without output wires connected to an external system.

1) Set the multimeter to measure current and connect the multimeter to an active output (an output is inactive if it does not have a chipset installed next to the terminal block).
2) Record the current in mA.
3) Confirm that the value is accurate using the following equation.

4) Repeat for each active output.

$$mA = \frac{(16) * (MeasuredValue - MinValue)}{FullScale} + 4$$

mA = milliamp output value

Full Scale = Max Value - Min Value

Connecting to an External Monitoring System

1) Connect two wires from the active output to the appropriate connection on the external system.
2) Repeat for each active output.
3) If the output does not have a chipset, it is not in use.

7.8 Chlorine Shock Mode

Chlorine shock mode is available to provide a high level of chlorine for a relatively short period of time.

Two menus control this feature:

1. Shock Chlorination
2. Cl Shock Set Point

   >>Duration

During normal operation, the analyzer controller operates Cl dosing systems based on Cl Set Point 1.

When Cl shock mode is turned ON, the controller will automatically control the Cl dosing system based on the Cl Shock Set Point. This will only affect Cl relay #1 and the 4-20 mA Control Output. Cl relay #2 will still be controlled based on Cl Set Point #2.

Once the Cl Shock Mode is turned ON, the controller controls the Cl Shock Set Point for the user-selected Duration and then automatically shuts Cl Chlorination Mode OFF. Then the controller returns to operating the Cl Set Point 1.

To turn on Cl Shock Mode:

1. Enter the Cl Shock Set-point, then press OK.
2. Enter the Duration, then press OK.
3. Turn Cl Shock Mode ON.

You will also need to adjust the Cl P-factor (Technician Menu). A low P-factor will make slower changes to Cl dosing; a high P-factor will make faster changes to Cl dosing. If you have trouble reaching the Cl set-point, use a higher P-factor. If you greatly overshoot the set-point, use a lower P-factor.

8 Relays and Closed-Loop Control

There are 6 dry-contact relays on the I/O module. Five of the relays may be used for direct control of closed-loop systems. All of the relays may be used as dry-contacts and will operate based on the settings, specifically the set-points, selected in the Operator Menu.

8.1 Connecting external equipment to the relays

This is only required if the relays are being used to power and control external dosing equipment. The relays will act as dry contacts if no power is supplied. A dependent power

supply should be used such that no equipment will be activated unless the process line has flow.

8.2 Wiring to Dosing Systems

HYDROGUARD controls chemical dosing systems using a series of electronic relays that start and stop the dosing pumps. Each relay opens and closes a switch that activates a separate pump or piece of equipment.

The line (live) wire of the dependent power source connects to the connection labeled “Common” on each relay. The line wire of each controlled system is connected to the normally open (NO) or normally closed (NC) connection of each relay as appropriate. Normally Open means that the relay will be open (i.e. no power from the relay) until the controller calls for power; Normally Closed means that the relay will be closed (i.e. power from the relay) until the controller calls to stop power.

1) Verify that the power switch or circuit breaker to the dependent power source is off.
2) Connect the earth wire to the ground return wire from each of the external dosing systems.
3) Connect the neutral wire to the return wire from each of the external dosing systems.
4) Connect the line (live) wire to the connector marked Common of each active relay.

Caution

Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

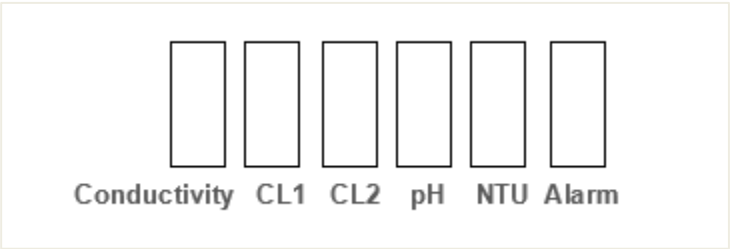


Figure 22: Relay positions on board

The following table lists the relays and the dosing systems they control:

Table 17 - Relays and their controlled dosing systems

Relay #	Relay name	Control
1	CL1	Main chlorine system. On/Off or Proportional. Proportional controls pulse length or pulse frequency (PL/PF)
2	CL2	Secondary chlorine system (On/Off only – no proportional control)
3	pH	Acid or base dosing. On/Off or Proportional. Proportional controls pulse length or pulse frequency (PL/PF)
4	NTU	Nephelometric Turbidity Units – Controls the injection of flocculants or coagulants
5	Alarm	Activates an external alert when certain alarm types are registered
6	Conductivity	Used only with the optional Conductivity module

9 Setting Proportional Control

9.1 Proportional Control Overview

HYDROGUARD controls dosing proportionally. This method sets dosing rates in relation to how far current chemical levels are from the set point. The dosing rates gradually decrease as chemical levels get closer to the set point.

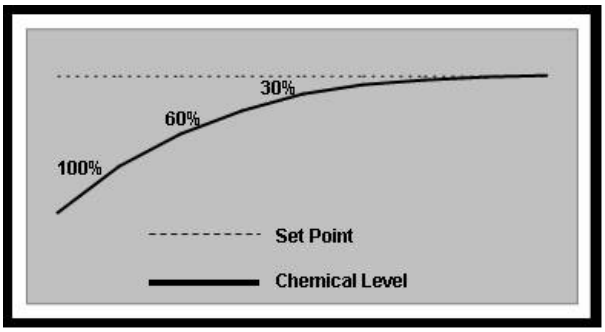


Figure 23: Proportional Control of Chemical Dosing

If water chemical levels are far below the set point, HYDROGUARD will control the dosing systems to operate at full capacity (100%). As the controller senses chemical levels rising and getting closer to the set point, it will control the dosing systems to slow down to a lower capacity (60%). As chemical levels get even closer to the set point, the dosing system will slow down even more (30%), and so on, until the chemical level reaches the set point.

9.2 Setting Proportional Factor

Proportional control of chemical dosing requires configuration according to various factors. The primary factors are the ratio between the system size and the rate the chemical dosing systems can feed chemicals, and the delay time between when the chemical level changes and when it is sensed by the controller.

In large systems, changes in chemical levels occur slowly. The dosing systems must feed large amounts of chemicals for a long period of time in order for a change to be noticed. The

chemicals also disperse slowly in larger systems. Smaller systems, on the other hand, react much faster.

The length of time between the change and when the controller identifies the change also affects proportional control. The controller can only identify water chemical levels after they have been distributed throughout the system and have returned to the analyzer. This lag time varies for each system and in general, systems with **shorter lag-times** will operate better with **high proportional factors (P-factors)** and systems with **longer lag-times** will operate better with **low P-factors**.

The following figure explains the process of determining the chlorine P factor.

Note

After each cycle of dosing, please take into account the system's cycle time, e.g., the time it takes for the chlorine to dissolve in the water reservoir, before measuring the chlorine levels.

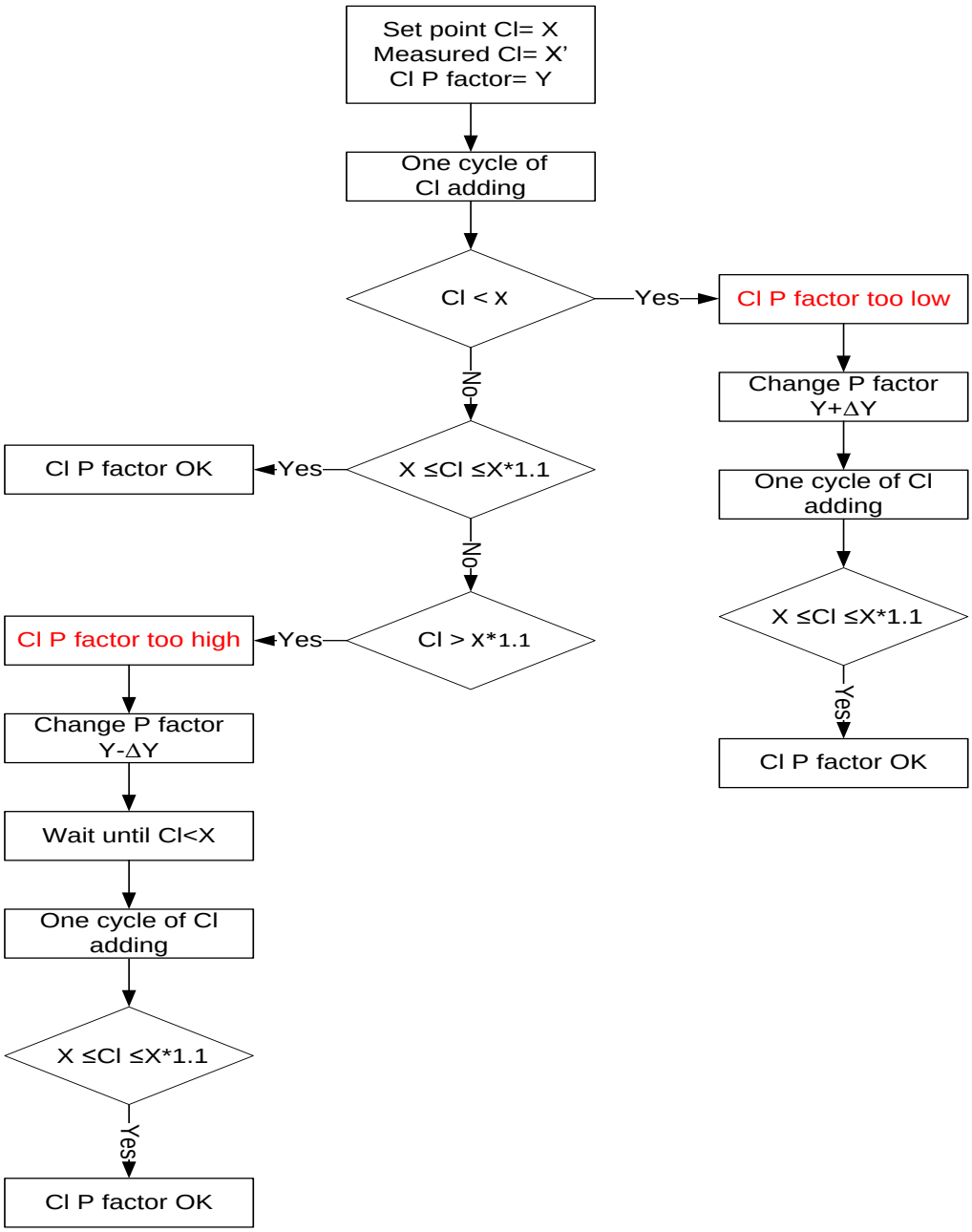


Figure 24: P-factor computation example

9.3 Setting Pump Period

Pump period is a single cycle during which the dosing pump operates and then rests. Proportional control divides the pump period into two distinct phases: active and at rest.

In general it is recommended to operate in a short cycle, i.e., 00:30 seconds. For large systems, or if you activate solenoid valves, you may consider longer pump periods.

9.4 Step By Step Proportional Settings

1) Complete the installation of all controller features (electrical, water, feeding systems and electrodes).
2) Calibrate the controller to the water chemical values at the sample point.
3) Set the proportional factor and the pump period for the chlorine and the pH per the recommended setting in sections 9.2 and 9.3:
    a) Press Menu button.
    b) Press Up and Down buttons together. The first screen to appear is Cl p Factor.
    c) To change Cl p Factor value, press OK, insert technician password and press OK again.
    d) Change value by pressing Up and Down. When correct value is reached, press OK.
    e) To set Cl pump period, press Menu button again to get to Cl pump period screen. Press OK, then press Up or Down to determine correct value. When correct value is reached, press OK.
    f) Now set pH p Factor and pH p pump period: Press Menu a few times until reaching the pH p Factor screen. Press OK and then Up or Down to determine correct value. When correct value is reached press OK.
4) Let the controller operate the chlorinator and the pH correction devices and make sure that chemicals are injected into the water.
5) Watch the chlorine and pH as they change. We recommend that you record the values frequently so that the process is closely monitored.
    a) If the values greatly exceed the set point, you need to decrease the proportional factor.
    b) If it takes too long to get to the set point, you need to increase the proportional factor.

Note

In large systems the delay time between injection of chemicals and registering the change in the controller can be quite long (30 minutes or more).

For this reason the process of getting a good control loop can take 15 minutes in very small systems, and up to a few hours in large systems.

10 Technical Specifications

MECHANICAL DATA	
Dimensions (controller) (W x H x D)	670 x 330 x 130mm (26.4" x 13" x 5.1")
Dimensions (mounting board)	800 x 550 x 5 mm (31.5" x 21.7" x 0.2")
Cable entries	Pg 9 Cable Glands
Max. ambient temperature	2°C to 50°C (35.6°F to 122°F)
Weight Approx.	11kg (24.3 lbs.)
ELECTRICAL CONNECTION	
Power supply	100-115VAC/1A; 200-230VAC/0.5A; 50Hz/60Hz
Power consumption	Approx 60 VA
Power supply for RTC	3.6V Lithium Battery memory
DATA SERIAL OUTPUT SIGNAL OUTPUT	
RS 485	Standard
4-20mA	1, Optional 2,4 or 6
RELAYS	
CL (Chlorine) set point 1	250VAC/DC 4A Max
CL (Chlorine) set point 2	250VAC/DC 4A Max
pH 1	250VAC/DC Max
Turbidity control 1	250VAC/DC 4A Max
General Alarm	250VAC/DC 4A Max
Temperature control	250VAC/DC 4A Max
DISPLAY	
5.5" Large Graphic Monochrome Display	
CHLORINE MEASUREMENT	
Measurement	Free and/or Total chlorine
Sensor	Colorimetric multi-spectrum sensor
Cell cleaning	Automatic self-cleaning mechanism (patent)
Mixing technology	Inner solenoid activated active mixer (patent)
Measurement range	0 to 10ppm
Measuring interval	2 to 10 minutes
Max. inlet operating pressure	1 bar (14.5 psi)
Flow rate colorimetric cell	3 to 12 LPH @ 1bar (0.75 to 36 GPH @ 14.5 psi)
Working Temperature	1°C to 45°C (33.8°F to 113°F)
REAGENTS	
Reagent type	DPD1, DPD3, DPD4
Reagent consumption	Min ~0.033 ml per sample
Shelf life	Unmixed DPD1 &DPD4 3 years, DPD3 15 months Mixed: Recommended 60 days
TURBIDITY MEASUREMENTS	
Sensor	White light nephelometry (90° and 180°)
Measuring range	0 to 200 NTU
Accuracy	2-4% FS
Resolution	0.001
Colorimeter body material	PP
Bubble removal	Automated internal mechanism
Cell cleaning	Automated internal mechanism

pH MEASUREMENT*	
Measurement range	0 to 14
Sensor	Ceramic diaphragm and gel filling
Input impedance	$0.5 . 10^{12}\Omega$
ORP (REDOX) MEASUREMENT*	
Measurement range	0 to 2000mV
Sensor	Ceramic diaphragm and gel filling
TEMPERATURE MEASUREMENT*	
Sensor	PT-100
Measuring range	0^{o}C to 100^{o}C (32°F to 212°F)
MEASURING CELL	
Working temperature	1°C to 45°C (33.8°F to 113°F)
FLOW REQUIREMENTS	
Measuring cell flow rate	35l/h - 60l/h
Inlet pressure	0.3 bar (4.4 psi) to 1 bar (14.5 psi)
Outlet pressure closed cell	Up to 0.9 bar (13 psi)
Flow switch type	Rotary switch
FLOW MEASUREMENT	
Frequency input or 4-20mA input	via I/O card via NTU card
Measurement range	0-1,000 m3/hour
pH VALUE CONTROL	
Control function	P or PI or On/Off or frequency
Characteristics	Normal / Inverted
Relay function	Pulse Length proportional controller Pulse Frequency proportional controller
ORP (REDOX) CONTROL	
Control function	High alarm as chlorine override
CHLORINE CONTROL #1	
Control function	PI or On/Off or frequency
Proportional band	Yes
Relay function	Pulse Length proportional controller Pulse Frequency proportional controller
CHLORINE CONTROL #2	
Control function	On/Off
Proportional band	No
Relay function	Pulse Length proportional controller Pulse Frequency proportional controller
DATA LOGGER	
Memory	256Kbit
Lines	1000
Recording interval	1-360 min
Event logger	Yes
Total relay on time	Yes
SECURITY	
Operation password	Yes
Technician password	Yes

*Optional Feature

Datasheet rev. 1.6

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